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Mortimer D. Leonard

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MELVILLE T. COOK, EDITOR

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AN ANNOTATED BIBLIOGRAPHY OF PUERTO RICAN ENTOMOLOGY

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This is an attempt to gather together all the published references to the entomology and the insects of Puerto Rico. The year 1932 is covered but several titles which were due to appear early in 1933 are included even tho two or three of the citations may be some what incomplete. A total of 711 titles are listed. Of these the compiler has been able to examine all but 28; those not personally examined are indicated by an asterisk. A few of the references do not mention insects from Puerto Rico but have been included in order to correct publisher errors. They are placed in brackets.

The task of compilation has been greater than at first expected and without the generous help of several people the results would have been much less complete. Chief of these has been Prof. C. R. Crosby of Cornell University who has supplied many references and given great assistance in the final preparation of the manuscript. Mr. A. J. Mutchler, of the American Museum of Natural History, has located many references on Coleoptera thru his wide knowledge of the literature of this group which otherwise would have been overlooked. Mr F. W. Watson of the same institution and Dr. W. T. M. Forbes of Cornell University have both helped with titles on Lepidoptera. Dr. Wm. A. Hoffman of the School of Tropical Medicine supplied abstracts of several references and Dean Carlos A. Figueroa of the College of Agriculture loaned several rare volumes dealing with early Puerto Rican agricultural literature. Acknowledgment is due to the following librarians: Miss Ida R. Hood of the American Museum of Natural History, Mr. W. W. Ellis, of the New York State College of Agriculture at Cornell, Miss Mabel Colcord of the United States Bureau of Entomology and to Mr. J. I. Otero of the Insular Experiment Station, as well as to their associates for many courtesies and for assistance in finding many of the publications consulted. Dr. Geo. N. Wolcott at the Insular Experiment Sta-

tion at Río Piedras has been good enough to go over the manuscript and proof and has made several corrections and additions.

Anonymous. 1903. Algunos remedios contra los principales insectos que atacan el tabaco. Dept. Interior P. R., Neg. Agr. y Minas, Bol. Agr. 17, pp. 5–12. San Juan, November.

An abstract in Spanish of U. S. Farmers' Bul. 120, 32 pp., 1900 by L. O. Howard on "The principal insects affecting the tobacco plant."

1904. Some injurious garden and field insects in tropical America. U. S. Dept. Agr., Bur. Ent. Bul. **44**: p. 84,

A brief record of the damage done by several injurious insects, specimens of which were sent to the Bureau in August 1903 by O. W. Barrett of the P. R. (Mayagüez) Agr. Exp. Sta. It is chiefly of interest because these records are probably the first published notes from this Station on injurious insects. They are as follows: an aphid on squash; the leaf-beetle, *Cerotoma denticornis* Ol., infesting cowpeas, *Systena basalis* Duv. inuring sunflowers and a leafhopper, *Agallia tenella* Ball, injuring beans, cowpeas and other plants.

(Pedreira in his Bibliografía Puertorriqueña gives the authorship of this paper to L. O. Howard but there is no evidence to show that it was written by him.)

*1911. Leyes y reglamentos concernientes a la importación e inspección de plantas, enfermedades de insectos y plagas en la Isla de Puerto Rico. Junta de Comisionados de Agricultura Puerto Rico Circ. No. 1 Div. of Ent. Bur. Supplies, Printing & Transp., 7 pp., San Juan. (Published in English & Spanish)

Compiled from Act 60, Special Session Legislative Assembly 1910 and Act 45, Legislative Assembly 1911.

Anon. (pob. Wetmore. Alex.) 1913. Useful birds of Porto Rico. Porto Rico Progress **4**(13): 13, 14. San Juan, P. R.

A note on the control of the "changa" or mole cricket by herons. The article is probably by Alexander Wetmore.

1913 *b*. Destruction of mole crickets in Puerto Rico by the heron or gaulding. Agr. News, Barbados, B.W.I. **12**(298): 314.

Note on Wetmore's article on Useful Birds in Puerto Rico abstracted from the Experiment Station Record, June 1913.

1915. Law and regulations pertaining to the importation of plants to the island of Puerto Rico. Plant Quarantine Regulations. Ins. Exp. Sta. P. R. Circ. **5**: 1. April 12.

1919 *a*. Análisis de insecticidas. Rev. Agr. P. R. 3(5): 61–62.

1919 *b*. Skunks and toads. Agr. News, Barbados, B.W.I., 18: (458): 361.

Mention is made of the abstract on p. 362 of the Rept. Div. Ent., Ins. Exp. Sta. P. R. for 1917–18, part of which refers to the possible introduction of the toad, *Bufo marinus* L., into Puerto Rico.

1919 *c*. Entomology in Puerto Rico. Agr. News, Barbados, B. W.I. 18, (458): 362–363.

The Ann. Rept. Div. Ent., Ins. Exp. Sta. P. R. for 1917–18 is abstracted.

1920. Estadística de los tanques de inmersión construídos en esta isla hasta junio 30, 1920. Rev. Agr. P. R. 5(5): 38.

Data on results of use of dipping tanks for the cattle tick.

1920. Quarantine department report on inspections and interceptions, all ports and stations, for the quarter ending March 31, 1920. Qtrly. Bul. Fla. State Plant. Bd. 4(3): 102–103.

Aspidiotus destructor intercepted 29 times on shipments from Cuba, Puerto Rico and the Isle of Pines.

1921. Report of the quarantine department from October 1, 1921, to December 31, 1921. Quart. Bul. State Plant Bd. Miss. 1(4): 17–24., 4 figs.

Lepidosaphes beckii intercepted from Puerto Rico on orange.

1923. Pests collected from imported plants and plant products from January, 1922 to December 31, 1922, inclusive.

Aleurothrixus howardi on banana and *A. floccosus* on citrus foliage from Puerto Rico.

1924. The effect of *Melinus minutiflora* on ticks. Ann. Rept. Ins. Exp. Sta. R. P. 1923–1924, pp. 102–103.

Account of an investigation on the effect of molasses grass on the cattle tick.

1924. Report of hearing held by the Federal Horticultural Board to consider the advisability of restricting or prohibiting the entry from Puerto Rico of fruits and vegetables into the United States. Jour. Dept. Agr. P. R. 8(1): 46. (Issued August 1925).

Reference is made to the West Indian Fruit Fly, *Anastrepha fraterculus* Wied. and to the lima bean pod-borer, *Maruca testulalis* Geyer.

*1925. Field studies and demonstrations in malaria control. Rockefeller Found. 11th. Ann. Rept. Intern. Health Bd. 1924, pp. 73–84, New York, January. (Abs. in Rev. Appl. Ent. B **14**: 51–52).

Conditions in Puerto Rico reported on, including the comparative abundance of the 3 species of Anopheles present.

1926. Studies of the malaria problem in Puerto Rico. P. R. Health Rev. **2**(5): 22–28. (Abs. in Pub. Health Repts. **42** (13): 897, Washington, D. C., April 1, 1927).

Influence of vegetation and small fish on mosquito abundance.

1927 *a*. Se introducen parásitos del taladrador de la caña de azúcar en Puerto Rico. Rev. Agr. P. R. **19**(1): 33. July.

A Spanish translation of a review in Facts About Sugar of an article by L. A. Catoni in Jour. Dept. Agr. P. R. 10:252–254, 1910 dealing with parasite introduction into Puerto Rico.

1927 *b*. Insect pests of sugar cane (including utilization of parasites). Proc. 2nd. Conf. Internat. Soc. Sugar Cane Technol., pp. 57–62, Havana, Cuba Sugar Club.

A record of a preliminary meeting of the committee for the section on insect pests of sugar cane at which there was a general discussion of borers, mostly *Diatraea saccharalis* Fab.; losses and the factors causing them for various countries are discussed, among which it is stated that in Puerto Rico the infestation is inversely proportional to rainfall.

1927 *c*. Studies of the malaria problem in Puerto Rico. P. R. Health Rev. **2**(8): 25–32.

Malaria investigations in 1924 and 1925 which include notes on *Anopheles grabhami* Theo. and *A. vestipennis* D. & K.

*1927 *d*. Studies in the malaria problem in Puerto Rico. P. R. Health Rev. **2**(10): 27–32 and **2**(12): 25–31. (Abs. in Rev. Appl. Ent. B 16 p. 64 and in U. S. Pub. Health Rep. **42**(39): 2395 and **42**(51): 3142).

Notes on the comparative abundance, numerical and seasonal, and biting and breeding habits of the 3 species of *Anopheles* present.

1928 *a*. Algunas consideraciones sobre la industria apícola. Rev. Agr. P. R. **21**(2): 56, 82.

Notes on beekeeping in Puerto Rico.

1928 *b*. Sugestiones a los principiantes en apicultura. Rev. Agr. P. R. **21**(4): 153, October.

Brief suggestions on beekeeping.

1928 *c*. Report of bureau of malaria control 1926–27. P. R. Rev. Pub. Health & Trop. Med. **3**(7): 279–286; **3**(9): 376–385. (Abstracted in Rev. Appl. Ent. 16: 239 and 209 respectively and the former also in U. S. Pub. Health Repts. 43(30): 1992–1993, 1928).

Notes on the breeding and habits of the 3 species of *Anopheles* present.

*1929. Report of bureau of malaria control 1926–27. Rept. Comm. Health P. R. 1926–27, pp. 62–95. (Abs. in Rev. Appl. Ent. B **17**: 218).

Drainage problems discussed; tests of durability of screening materials; Paris green at weekly intervals for *Anopheles albimanus* too infrequent.

1931. El gorgojo del ñame del guineo. Bol. Agr. (P. R. Dept. Agr.) **1**(4): 3–4.

Brief report on the results of a survey of 3 districts to determine the amount of infestation by the banana root weevil.

1932. Florida beetle put to test, curbing P. R. citrus pest. The Produce News, June 11, New York, front page.

Brief note on original shipment of Australian lady beetles, *Rodolia cardinalis*, to Puerto Rico by the Florida State Plant Board for the control of *Icerya purchasi* on citrus.

* **Abad, José Ramón.** 1885. Puerto Rico en la exposición de Ponce en 1882. Memoria redactada de orden de la Junta Directiva de la misma. 351 pp. El Comercio, Ponce, P. R. (Reference from Colón, E. D. 1930).

Suggestions for the proper care of bees are given and it is stated that some of the people are engaged in beekeeping.

Abbad y Lasierra, Fray Iñigo. 1788. Historia geográfica, civil y natural de la isla de San Juan Bautista de Puerto Rico, 508 pp. + X, Madrid. (Nueva Edición, anotada en la parte histórica y continuada en la estadística y económica por José Julián de Acosta y Calbo, Puerto Rico, 1866).

Chapter 35 deals briefly with the natural history of the Island; on pp. 457–462 is probably the earliest general account of the more important groups of insects present with special reference to those annoying to man and animals; no scientific names are given.

Aldrich, J. M. 1905. A catalogue of North American Diptera. Smithsonian Miscl. Coll., part of Vol. **46**, (1444), 680 pp.

Records all West Indian species described thru 1903, including many from Puerto Rico.

Alexander, C. P. 1912. A peculiar new crane fly from Puerto Rico. Psyche 19: 63–66, 1 pl.

Megistomastix portoricensis as a new genus and species.

1913. A synopsis of part of the neo-tropical crane-flies of the subfamily Limnobiinae. Proc. U. S. Nat. Mus. Vol. **44** (1966): 501.

Mongoma niveitarsus as a new species from Puerto Rico.

1914. A revision of the American species of Tanypremna Osten Sacken and Megistocera Wiedemann. (Tipulidae, Diptera). Jour. N. Y. Ent. Soc. **22**(3): 216–217.

Megistocera longipennis Macq. listed from Puerto Rico on the authority of Roeder.

1932. The craneflies of Puerto Rico. Jour. Dept. Agr. P. R. **16**(4): 347–387.

Ashmead, W. H. 1900. Report on the aculeate Hymenoptera of the islands St. Vincent and Grenada, with additions to the parasitic Hymenoptera, and a list of the described species of the West Indes. Trans. Ent Soc. London for 1900 Pt. 2 (July), pp. 207–368.

Lists many species from Puerto Rico.

Aubé, Ch. 1844. Revision de la famille des Pselaphiens. Ann. Soc. Ent. France, 2 Ser., Vol. **2**, p. 120.

Reichenbachia usera listed from Puerto Rico (as Bryaxis).

Aurivillius, Chr., Wagner, H. and **Strand, E.** 1911 to date. Lepidopterorum Catalogus. Berlin.

Forty odd Fascicles have appeared to date by various authors in which many species are listed as specifically occurring in Puerto Rico.

Bagué, Jaime. 1918. Extirpación de la garrapata. Rev. Agr. P. R. 1(1 and 2): 81–85. (Also as Est. Exp. Ins. P. R. Circ. **18**, 12 pp., 1919.)

Notes on the campaign against the cattle tick.

1920. Annual report of the veterinary inspector. Ann. Rept. Ins. Exp. Sta. 1919–20, pp. 95–101.

Report on dipping vats for cattle tick eradication.

1921. La piroplasmosis o fiebre tejas. Ins. Exp. Sta. P. R. Circ. 45, 5 pp.

Only reliable method for control of Texas fever in Puerto Rico is extermination of the cattle tick; the value of arsenical dips is discussed.

1929. ¿Garrapata o ganado? Sección española del Boletín de la Unión Panamericana, April. (From Pedreira p. 208). (Also in the Rev. Agr. P. R. **22**(10) : 139, April, 8 figs.)

A general account of the cattle tick problem with special reference to the situation in Puerto Rico and methods adopted for handling it there.

* **Baldorioty de Castro, Román.** 1865. Memoria descriptiva de la cuarta feria y exposición pública de la agricultura, la industria y las bellas artes de la isla de Puerto Rico. By the Secretary of the Commission. San Juan, P. R. (Reference from Colon, E. D. 1930, p, 21, ref. no. 41, and p. 156).

At the fourth public exposition held in the Island in 1865 Don Alejo Fernández of Aguadilla exhibited wax and honey as the products of 250 hives of bees.

Ballou, H. A. 1913. Root borers and other grubs in West Indian soils. Imp. Dept. Agr. W. I., Pamphlet Ser. No. 73, 38 pp.

Puerto Rican references: brief notes on *Lachnosterna* sp., p. 17; *Diaprepes spengleri* listed as injurious, p. 36; *Lachnosterna* listed as injurious, p. 37; *Strategus titanus* listed as injurious, p. 38.

1915. Notes on Puerto Rico insects. Agr. News, Barbados, B. W. I., August 28, 14, (348), p. 282.

Abstracts are given of P. R. Bd. Comm. Agr. Circ. 6 by Crossman and Wolcott on the changa and of U. S. D. A. Bul. 192 by T. H. Jones on Vegetable Insects in Puerto Rico, both of which see.

1916. Dangerous hard-backs. Agr. News, Barbados, 15 (359) : 42–43, 5 figs.

The injury to sugar cane roots in Puerto Rico by *Stratacgus titanus* is referred to.

Baly, J. S. 1886. Descriptions of uncharacterized species of Diabrotica. Trans. Ent. Soc. London, Pt. 4, pp. 443–444.

D. graminea described as a new species from Puerto Rico.

Banks, Nathan. 1901. Some spiders and other Arachnida from Puerto Rico. Proc. U. S. Nat. Mus. **24**: 217–227, 1 pl.

Report on a collection made by August Busck; 49 species of spiders and 5 other arachnids treated, of which 4 species of spiders are described as new.

1917. New mites, mostly economic (Arach., Acar.). Ent. News **28**(5): 194, pl. 14, fig. 5 and pl. 15, fig. 13.

Tetranychus antillarum described as a new species from leaves of *Leonotis nepetafolia* and *Asclepias curassavica* from Puerto Rico.

1919. Antillean Isoptera. Bul. Mus. Comp. Zool. **62**(10): 484–489.

Nasutitermes creolina from Vieques Id. and P. R. and *N. discolor* from Culebra Id. and El Yunque, both as new species (paratypes) and *N. morio* listed from Puerto Rico.

Banks, N. and **Snyder, T. E.** 1920. A revision of the nearctic termites. U. S. N. Mus. Bul. **108**, p. 82.

Nasutitermes costaricensis Holmg listed from Puerto Rico.

Barber, H. G. 1923. A preliminary report on the Hemiptera Heteroptera of Puerto Rico collected by the American Museum of Natural History. Am. Mus. Novitates No. 75, 13 pp.

Several new species described.

Barber, H. G. and **Bruner, S. C.** 1932. The Cydnidae and Pentatomidae of Cuba. Jour. Dept. Agr. Puerto Rico, **16**(3): 231–284, pl. 25, fig. 1.

Geocnethus reversus new species, type and paratypes from Mayagüez, Río Piedras and Isabela, P. R.

Barrett, O. W. 1902. The changa or mole cricket. (*Scapteriscus didactylus* Latr.) in Puerto Rico. P. R. Agr. Exp. Sta. (Mayagüez) Bul. **2**, 19 pp., 1 fig. (Also a Spanish edition).

1904. Control of the brown ant (*Solenopsis geminata* Fab.) in orange orchards. (Also a Spanish edition). P. R. Agr. Exp. Sta. Circ. **4**, 3 pp.

Brief account of life-history, injuries and remedial measures.

1906. Report of the entomologist and botanist. Investigations in entomology and plant pathology. P. R. Agr. Exp. Sta. (Mayagüez), Rept. for 1905, pp. 22–23.

First record of *Zagrammosoma multilineata* Ashm. parasitic on the coffee leaf-miner; cotton leaf worm parasitized by *Chalcis annulata* Fab.

1928. The tropical crops. MacMillan Co., New York, 445 pp.

Many references thruout to the principal injurious insects of Puerto Rico.

Barrow, E. H. 1924. White grubs, *Lachnosterna* sp., and larvae of the weevil root-borer, *Diaprepes spengleri* L., attacking sugar cane in the Guánica district of Puerto Rico and methods for controlling them. Jour. Dept. Agr. P. R. **8**(2) : 22–26.

Bastón, J. 1928. Produciendo mosquitos. Rev. Agr. P. R. **20**(5) : 239 and 245.

Notes on breeding and control of mosquitoes.

Berger, E. W. 1921. Natural enemies of scale insects and whiteflies in Florida. Qrtly. Bul. Fla. State Plant Bd. **5**(3) : 147–148, fig. 18.

Eucalymnatus tesselatus is recorded as being found infested by the fungus, *Aschersonia cubensis*, in material received from Puerto Rico.

Bigot, J 1877. Dipteres nouveaux ou peu connus. IX. Ann. Soc. Ent. France, Ser. 5, Vol. **7**, p. 46.

Lucillia semiviolacea as a new species from Puerto Rico (as *Somomyia*).

Bishoff, Augusto. 1918. Extirpación de la hormiguilla. Rev. Agr. P. R. **1**(1 and 2) : 38–42.

Suggestions for the control of ants.

Blake, Doris H. 1928. Notes on some West Indian Chrysomelidae. Bul. Brooklyn Ent. Soc. **23** : 93–98.

Dysonychia spilotrachela as a new species from Haiti and Puerto Rico.

Boheman, C. H. 1865. Monographia Cassididarum **3** : 333–334.

Coptocycla glaucina as a new species from Puerto Rico.

* **Bovel, J. R.** 1918. Report of the Department of Agriculture, Barbados, for 1916–1917, 62 pp. (Abs. in Rev. Appl. Ent. **6** : 393).

Stated that related species of *Diaprepes* and *Phytalus*, so trouble-

some to cane in Barbados, are on the increase in Puerto Rico and very injurious there.

* **Bovel, J. R.** and **d'Albuquerque, J. P.** 1917. Report on the sugar-cane experiments for the season 1915–1917. Dept. Agr. Barbados, 79 pp, 56 tables. (Abs. in Rev. Appl. Ent **6**: 58.)

Varietal and manure experiments inconclusive because of severe injury by *Diaprepes* and *Phytalus*. Stated that in Puerto Rico the the cost for handpicking for their control in one small district was about $6,000 and yet they increased.

***Box, H. E.** 1924. Report upon a trip to Puerto Rico, April-July, 1924, 22 pp., Berbice, British Guiana, S. Davson & Co., Ltd., November (Abs. in Rev. Appl. Ent. 13: 86).

Record of a trip made to study the Tachinid, *Lixophaga diatraeae* Towns., and to transport it into British Guiana; notes on the principal sugar cane insects of Puerto Rico and their parasites, especially *L. diatraeae*, including some observations on its distribution and incidence there.

1925. Porto Rican cane grubs and their natural enemies, with suggestions for the control of Lamellicorn larvae by means of wasp parasites (Scoliidae). Jour. Dept. Agr. P. R. **9**(4): 291–356.

*1927 *a*. Notas sobre dos insectos perjudiciales a las matas de café en Venezuela, 19 pp., 10 figs., 11 refs., Caracas, Cámara de Comercio, March. (Abs. in Rev. Appl. Ent. **15**: 324).

In discussing the green scale, *Coccus viridis* Green, in Venezuela it is stated that *Azya orbigera* Muls., a well-known Coccinellid predaceous on various Coccids in South America, has been sent to Puerto Rico for possible establishment.

1927 *b*. Eleventh report upon entomological work, 24 pp., typescript. Central Aguirre, P. R., Central Aguirre Sugar Co., April 9th. (See abs. in Rev. Appl. Ent. **15**: 412–414.)

A detailed account of a trip to South America during January–April, 1927 to make further introductions of Braconid parasites of *Diatraea* and Scoliid parasites of cane grubs into Puerto Rico. Notes on *Diatraea* and its parasites in Venezuela are given together with notes on conditions on Puerto Rico that affect their introduction and establishment. (For another account of this trip see Catoni 1927.)

*1927 *c*. The moth borer problem in Barbados. A discussion and a recommendation. Dept. Sci. and Agr. Barbados, 5 pp.,

multigraph, Barbados, March 25. (Abs. in Rev. Appl. Ent. **15**: 430.)

Refers to the occurence of *Lixophaga diatraeae* in Puerto Rico as a parasite of *Diatraea saccharalis* and states that this parasite has apparently reached the limit of its effectiveness there. It is suggested that its introduction should be attempted from Puerto Rico into Barbados.

1928 *a*. Observations upon *Lixophaga diatraeae* Townsend, a Tachinid parasite of *Diatraea saccharalis* Fabr. in Puerto Rico. Bul. Ent. Res. **19**: 1-6, 1 fig.

1928 *b*. The introduction of Braconid parasites of *Diatraea saccharalis* Fabr. into certain of the West Indian Islands. Bul. Ent. Res. **8**(4): 365–370, 1 pl., 2 figs.

A further detailed account of the collection, rearing, shipment and introduction of Braconid parasites of *Diatraea saccharalis* F. into Puerto Rico as well as into Barbados, Antigua and St. Kitts. Stated that *Microdus diatraeae* Turner has already become established on the South Coast of P. R.; present paper deals mostly with *Ipobracon grenadensis* Ashm.

1931 The Crambine genera *Diatraea* and *Xanthopherne* (Lep., Pyral.). Bul. Ent. Res. **22**: 1–50, 5 pls.

Diatraea saccharalis Fab., pp. 22–26, synonymy, description and distribution, including Puerto Rico in its known range.

Bradt, Schuyler. 1932 *a*. Notes on Puerto Rican blackflies. P. R. Jour. Pub. Health & Trop. Med. **8**(1): 69–81 (2–11), 5 figs.

Original observations on the habits and development of *Simulium quadrivittatum* Loew with descriptions of its stages; brief notes also on *S. haematopotum* Lw. and *S. minusculum* Lutz.

1932 *b*. Nota sobre la mosca negra en Puerto Rico. P. R. Jour. Publ. Health & Trop. Med. **8**(1): included in 69–81 (pp. 12–14 of reprint).

This is an abstract in Spanish of the preceding.

Brau, Salvador. 1930. La colonización de Puerto Rico desde el descubrimiento de la isla hasta la reversión a la corona española de los privilegios de Colón. San Juan, P. R., pp. 296–298.

Brief references to great injury to bananas by ants in the early part of the 16th century; also to oranges and "cañafístula"; it is stated that the ants were so bad in houses that the residents of Caparra advanced this as one of the principal arguments for wanting

to move their city to the "Isleta"—the present site of the city of San Juan.

Brau Zuzuarregui, Mario. 1922. Pájaros útiles y perjudiciales á la agricultura. Rev. Agr. P. R. **8**(5&6): 13–18, 27–32; **9**(2& 3): 25–31, 17–20, 11 figs.

Brief account of the various insectivorous birds of Puerto Rico that should be protected, including several specifically mentioned as important enemies of *Scapteriscus vicinus, Diatraea saccharalis, Heliothis obsoleta, Laphygma frugiperda* and of *Phyllophaga* (*Lachnosterna*) spp.

1928. Divagaciones entomológicas. Rev. Agr. P. R. **21**(6): 211 and 239–240, 1 fig.

Brenner, Henry. 1916. Puerto Rico and its beekeepers. Am. Bee Jour. **56**: 380–381, 2 figs.

1918. Puerto Rican beekeeping. Am. Bee Jour. **58**: 51–52, 4 figs.

Brief general account.

Britton, N. L. 1930. Scientific survey of Puerto Rico and the Virgin Islands. Jour. N. Y. Bot. Gard. **31**: 167.

Brief note on entomological progress during winter and spring of 1929–30.

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del Campo, Alberto. 1923. La industria de la seda. Rev. Agr. P. R. **11**(1): 17.

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Notes are included on citrus insects and their control and on experiments in insect transmission of sugar cane mosaic.

1921. A los agricultores de Puerto Rico y especialmente a los cosecheros de algodón. Rev. Agr. P. R. **7**(3): 5–7.

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Carrión, Arturo L *1927 Preliminary report on a rat and flea survey of the City of San Juan Porto Rico P R Rev Pub Health & Trop Med **3** 131–145 (Reference and abstract from Wm A Hoffman)

During the first year of Survey 560 live rats were trapped on 53 6% of which fleas were found practically all were *Xenopsylla cheopis* with an occasional *Ctenocephalus* and a few *Echidnophaga gallinacea*; cheopis index for the year quite high—7 05

*1928 Preliminary report on a rat flea survey of the City of San Juan Puerto Rico Second paper P R Rev Pub Health & Trop Med **4**(2) 84–92 7 charts (Abs in Rev Appl Ent **17** 26)

Covers period of July 1927 thru June 1928, 53% of rats captured had fleas, of 2,000 fleas which were determined 99 5% were *Xenopsylla cheopis* Roths, the remainder being *E gallineacea, Ct canis* or *felis*, *Pulex irritans* and *Leptopsylla segnis* Schonh (*musculi* Dug), the flea index and cheopis index for the year were practically the same—6 6 *Mus alexandrinus* revealed the highest infestation for the year

*1929 Third report on a rat flea survey of the City of San Juan Puerto Rico P R Jour Pub Health & Trop Med **5**(2) 158–166 7 charts (Abs in Rev Appl Ent B **18** 248, also by same title in Pub Health Rept **45**(27) 1515–1520, 7 charts Washington D C July 4)

Xenopsylla cheopis Roths (over 500 per cent of total number caught), *Echidnophaga gallinacea* Westw *Ctenocephalus canis* Curt or *C felis* Bch and *Pulex irritans* L found on 60 per cent of rats captured

*1932 Final report on a rat flea survey of San Juan, Porto Rico Publ Health Repts **47** 193–201, Washington, D C (Reference and abstract received from Dr Wm A Hoffman)

This survey includes 3 consecutive years of work, during which period a total of 1,005 live rats were captured, of these 72 per cent were classed as *Rattus norvegicus* and *P alexandrinus* in proportions of 13 and 15 per cent respectively Fleas were obtained from almost

57 per cent of the rats, the total number for the 3 years being 7,145 or an index of 7.1 fleas per rat. Five species of fleas were encountered but of these *Xenopsylla cheopis* composed 98.5 per cent of the total catch. The concentration of rats is heaviest at the water-front and in the residential sections while the flea index is highest at the docks (almost 14 fleas per rat) and in the commercial district (almost 6 fleas per rat)

Catoni, L. A. 1920 *a*. Plagas de insectos que atacan a los árboles del género citro en Puerto Rico y cómo combatirlos. Rev. Agr. P. R. 5(4): 35–39

A brief popular account of the more important insects injurious to citrus in Puerto Rico and methods of control

1921 *b*. Dos plagas de algodón que no queremos en Puerto Rico Est Exp Ins P R. Circ. **41**, 9 pp.

Refers to the pink boll worm and the boll weevil of cotton not found up to that time in Puerto Rico

1921 *c* El gas hidrociánico como agente fumigante. Rev Agr. P R **5**(7): 27–36

Directions for the preparation and use of hydrocyanic acid gas

1921 *d* Insectos que atacan al hombre Rev Agr P R **6**(2): 47–49.

Brief popular account of the more important insects annoying to man in Puerto Rico

1921 *e* Insectos que atacan al algodón Rev Agr P R **6**(3): 25–31.

Brief popular account of the more important cotton insects in Puerto Rico

1921 *f* Plagas de insectos que atacan la palma de coco Rev Agr. P. R 7(3): 21–25

Brief popular account of the more important insects attacking the coconut in Puerto Rico

1921 *g*. Plagas de insectos que atacan la planta del tabaco. Rev. Agr. P R. 7(5): 45–50

Brief account of the more important tobacco insects in Puerto Rico.

1921 *h*. A los cosecheros de algodón en Puerto Rico Rev. Agr. P. R. 7(6): 25–26.

Brief notes of information for the cotton growers concerning the

presence of the pink bollworm in Puerto Rico and an interception of the boll-weevil.

1921 *i*. Plant inspection and quarantine report. Ins. Exp. Sta. P. R. Bul. 27, 23 pp. (also a Spanish edition 25 pp.).

1922 *a*. Informe de las actividades de la campaña de eradicación del gusano rosado en Puerto Rico llevada a cabo por el departamento de agricultura y trabajo. Rev. Agr. P. R. 8 (4): 15–22.

Notes on a clean up campaign against the pink bollworm.

1922 *b*. Plagas de insectos que atacan a las plantaciones de batatas. Rev. Agr. P. R. 9(3): 25–28.

Brief account of the more important sweet-potato insects in Puerto Rico and their control.

1922 *c*. Medidas para combatir las plagas de insectos. Rev. Agr. P. R. 9(4): 33–36.

Brief directions for the preparation and use of a few of the more important insecticides.

1922 *d*. Situación existente de varias plagas de insectos de los Estados Unidos. Rev. Agr. 9(4): 43–45.

1923 *a*. Aparatos apropriados para combatir las plagas de insectos. Rev. Agr. P. R. 10(1): 27–29.

Suggestions for various types of spray machines for use against injurious insects.

1923 *b*. Insectos que atacan a los animales domésticos. Rev. Agr. P. R. 10(3): 35–39.

Brief account of the more important insects attacking domestic animals with suggestions for their control.

1923 *c*. Gorgojos que atacan a las habichuelas y guisantes. Rev. Agr. P. R. 10(3): 49–51.

Brief account of pea and bean weevils with suggestions for their control.

1923 *d*. Las chinches harinosas y los métodos de combatirlas. Rev. Agr. P. R. 10(5): 35–37.

Brief account of mealybugs affecting citrus, cane and other plants in the Island and suggestions for their control.

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Brief account of the avocado weevil, *Heilipus lauri*, in Puerto Rico.

1924. Informe del servicio de inspección y cuarentena de plantas (1922–1923). Dept. Agr. P. R. 23 pp.

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Notes on a trip to Venezuela with H. E. Box to collect and introduce into Puerto Rico parasites of the sugar cane borer.

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Gonatista reticulata Thunberg mentioned as occurring in Puerto Rico.

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Cyrtopholis portoricae described as a new species from Puerto Rico.

1922. Notes on West Indian millipedes. Proc. U. S. Nat. Mus. **61**, Art. 10, (2431) : 1–15.

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Champion, G. C. 1898. A list of the clavicorn Coleoptera of St. Vincent, Grenada, and the Grenadines. Trans. Ent. Soc. London for 1898, p. 401.

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Chapin, E. A. 1930. *Canthonella,* a new genus of Scarabeidae (Coleoptera). Am. Mus. Novitates No. 409, March 18, 2 pp.

C. parva as a new species from Puerto Rico.

1932 Revision of the pleurostict Scarabeidae of Cuba and Isle of Pines II Rutelinae, Dynastinae, and Cetoniinae Ann Ent Soc Am **25**(2) 282–314, 3 pls

Dyscinetus picipes Burm , pp 293–294, described, the type locality stated as Puerto Rico, it is said to be common in this Island

Chapuis, F. 1866 Monograph des Platypides. Mem Soc. Royal des Sci Liége, 20 181–182

Platypus schaumi as a new species from Puerto Rico

Chardon, Carlos E 1923 Report of the special pathologist. Ann Rept Ins Exp Sta P R for 1921–22, pp 61–68 (Also a Spanish edition pp 67–74 1922)

A report on a study of the factors affecting the spread in the field of sugar cane mosaic, including periodic observations on all possible insect vectors made in 40 observation fields

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A biographical sketch of the outstanding naturalist of Puerto Rico in which reference is made to his contributions to the knowledge of the insect fauna of the Island

Chardon, C E and **Veve, R. A.** 1923 The transmission of sugar cane mosaic by *Aphis maidis* under field conditions in Puerto Rico Phytopathology **13**(1) 24 29 1 fig

Chevrolat, L. A. A. 1864 Coleoptères de l'île de Cuba Notes synonymies et descriptions d'espèces nouvelles Cinquieme memoire Ann Soc Ent France Ser 4 Vol 4 p 414

Psammodius gracilis is a new species from Cuba, Puerto Rico and Guadeloupe

Chevrolat, M Aug 1876 Donne la description de Curculionites provenant des captures de M le docteur Gundlach á l'île Porto-Rico Ann Soc Ent France, Ser 5 Vol **6** Bulletin pp (227–229) CCXXVII–CCXXVIX

Pachnaeus roseipes, *Lachnopus trilineatus* *Anchonus angulicollis* *Attelabus* (*Fuscelis*) *sexmaculatus* and *Anthonomus dentipennis* as new species from Puerto Rico and 5 other species also listed as occuring there

1877 Descriptions of new species of Heteromera from the island of Puerto Rico collected by Dr Gundlach Bul Soc Ent France, Ser 5, Vol **7** 8–10

Diastolinus fuscicornis, *Notoxus bipunctatus*, *Emenadia melanop-*

tera, Epicauta annulicornis, E obscuripennis and *Oracis geniculata* as new species from Puerto Rico

Notoxus dentipennis Chev cited by Gundlach and copied by Wolcott page 85 of this "List" is probably in error for *N bipunctatus* Chev since there seems to be no reference to a species of this name other than by the two authors mentioned above

Chittenden, F H 1919 The rice moth U S Dept Agr Bul. 783, 15 pp

Puerto Rican records of *Corcyra cephalonica* Staint, in rice sacks

Cintrón, M, and **Marques, N** 1926 Resultados obtenidos en la demostración número 91 sobre "represión del gorgojo del maíz" Rev Agr P R **17** 18 November

Results of a demonstration in the control of the corn weevil

Clark, B Preston 1919 Some undescribed Sphingidae Proc New Eng Zool Club **6** 100–101 pl X, fig 1

Protoparce brontes Drury var *smythi* is a new subspecies from Rio Piedras, P R

1922 Twenty five new Sphingidae Proc New Eng Zool Club **8** 8–9

Isognathus rimosa Grote var *molitor* is a new variety from Puerto Rico

Clark, Hamlet 1860 Catalogue of Halticidae in the collection of the British Museum (London) p 131

Aedmon sericellum is a new species from Puerto Rico

Cockerell, T D A 1895 Miscellaneous notes on Coccidae Can Ent **27**(9) 253 261

Aspidiotus destructor Sign listed from Puerto on coconut palm is the first Coccid record for the Island

1910 Some bees of the genus Augochlora from the West Indies Proc U S Nat Mus Vol **37** (1717) 493

Augochlora buscki as a new species from Puerto Rico

1919 Bees in the collection of the United States National Museum 3 Proc U S Nat Mus Vol **55** (2264) p 209

Agapostemon radiatus portoricensis as a new subspecies from Puerto Rico

Coll y Toste, Cayetano. 1914 A memoria in the Boletín Histórico de Puerto Rico 1 303

In this memoria prepared by Dr Coll y Toste he copies the Cédula

de Gracia (Decree of Grace) of August 10, 1815, Article 31 of which provides that the Governor of Puerto Rico establish a Quarantine against the introduction of ants and appointed two qualified persons to examine all incoming baggage, passengers and ships. This is probably the first quarantine in Puerto Rico against an injurious insect. (Leonard 1932 f. gives a translation of this decree in full).

Colón, E. D. 1919 *a*. El sulfato de amoníaco como insecticida. Est. Exp. Ins. P. R. Circ. **15**, 6 pp.

Notes on the possibility of using sulfate of amonia in Puerto Rico for the control of white grubs in sugar cane and at the same time as a fertilizer.

1919 *b*. Report of the director—Division of entomology, review of its work. Ann Rep. Ins. Exp. Sta P. R. for July 1, 1917 to June 30, 1918, pp. 29–59.

An excellent review, presented in considerable detail, of the work of Division of Entomology from its establishment up to that time.

1930. Datos sobre la historia de la agricultura de Puerto Rico antes de 1898, viii + 302 pp., Cantero Fernández y Cía., San Juan, P. R

On pp. 155–159 are notes regarding the introduction of bees into the Island and on apiculture based mostly on the writings of Ledru and of J. R Abad On pp. 227–232 brief reference is made to insecticides recommended and to several of the more important injurious insects: these are mostly on the authority of López Tuero and Herrera, which see On p. 276 are one or two brief quotations from J R. Abad on early (1854) attempts to produce silk in Puerto Rico.

1931. Informe anual del comisionado de agricultura y comercio correspondiente al año fiscal 1930–1931, (Puerto Rico), pp. 18–19, 95–109, 122–124.

A brief review of entomological activies of the Insular Experiment Station and the Plant Quarantine Section during the period covered.

Colón, Isidoro A. 1919 *a*. Insecticidas y fungicidas. Est. Exp. Ins. P R. Bol. **20**: 1–23.

Chemical notes on some of the more common insecticides and a table of analyses of samples examined from different sources in Puerto Rico.

Cook, Mel. T. and **Dozier, H. L.** 1925. Spraying citrus fruits in Porto Rico. Ins. Exp. Sta. P. R. Circ. **88**: 1–23.

Coquillett, D. W. 1899. New genera and species of Nycteribidae and Hippoboscidae. Can. Ent. **31**: 333–336.

Aspdioptera busckii as a new species and *Pterellipsis araenee* as a new genus and species from Puerto Rico.

1900. Report on a collection of dipterous insects from Porto Rico. Proc. U. S. Nat. Mus. Vol. **22**(1198): 249–270.

117 species in 79 genera are mentioned, of which 16 species and 3 genera are described as new.

1902. New acalyptrate Diptera from North America. Jour. N. Y. Ent. Soc. **10**(4): 190.

Agromyza viridula as a new species from Puerto Rico.

Cotton, R. T. 1917 *a*. The eggplant lace-bug in Puerto Rico. *Corythaica monacha* Stal. Jour. Dept. Agr. P. R. **1**(3): 170–173.

Complete account of life-history, description of stages, natural enemies and control.

1917 *b*. Life history of *Haltica jamaicensis* Fabr. Jour. Dept. Agr. P R. **1**(3): 173–175.

1917 *c*. Scale feeding habits of a Porto Rican millipede: *Rhinocricus arboreus* Saussure. Jour. Dept. Agr. P. R. **1** (3): 175–176.

A note on the considerable quantity of *Lepidosaphes beckii* consumed by this millipede.

1917 *d*. Las queresas y cómo combatirlos. Est. Exp. Asoc. Prod. Azúcar P. R. Circ. **9**: 1–7. Also in English as Circ. 9, Bd. Comm. Agr. P. R. Exp. Sta., 7 pp.

A popular article on the control of the more important scale insects.

1917 *e*. Report of the Assistant Entomologist. Ann. Rept. Ins. Exp. Sta. P. R. from 1st July to 30th June, 1917, pp. 106–122, 1 pl. 1 fig.

Notes on insects affecting tobacco, citrus and vegetables, and directions for making oil emulsion for citrus.

1918 *a*. Insectos que atacan las hortalizas en Puerto Rico. Rev. Agr. P. R. **1**(3): 119–131, 150–165, 198–212, 253–268.

This is a Spanish translation of Cotton 1918 c.

1918 *b*. Experimental work on the control of the white grubs of Porto Rico. Jour. Dept. Agr. P. R. **2**(1): 1–18.

1918 *c*. Insects attacking vegetables in Porto Rico. Jour. Dept. Agr. P. R. **2**(4): 265–317.

The most complete account to date.

1918 *d*. Medios para combatir los gusanos blancos. Est. Exp. Asoc. Prod. Azúcar P. R. Circ. **12**: 1–7.

Control measures for white grubs in Puerto Rico.

1922. Broad-nosed grain weevil. U. S. Dept. Agr. Bul. **1085**: 1–10, 1 pl.

Caulophilus latinasus Say mentioned as known to occur in Puerto Rico.

* **Cox, O. H., Carrión, A. L., & Fox, C.** 1928. Rat-flea survey of the port of San Juan, Porto Rico—a preliminary report. Pub. Health Rept. **43**(11): 611-616, 2 charts. (Abs. in Rev. Appl. Ent. B **16**: 163–164.)

Results of the survey made 1926–1927 and the species of fleas found and their comparative abundance.

Crawford, J. C. 1913. Descriptions of new Hymenoptera. Proc. U. S. Nat. Mus. Vol. **45**(6): 244.

Ganaspis hookeri as a new species parasitic on *Anastrepha fraterculus* in Puerto Rico.

Crawley, J. T., Johnson, J. R., and **Van Dine, D. L.** 1911. Organización de la estación y cultivo de la caña de azúcar en Puerto Rico. Insectos de la caña y enfermedades de la caña. Est. Exp. de Cañas de la Asoc. Prod. Azúcar P. R., 49 pp. Progress Pub. Co., San Juan.

Crespo, M. A. 1919. El comején (Termes sp.). Rev. Agr. P. R. **3**(6): 35–38, 2 figs.

Brief general account with control measures.

1920. Un insecto muy dañino a las palmitas del coco. El escarabajo rinocerante (*Strategus quadrifoveatus*). Rev. Agr. P. R. **4**(3): 47–48. (Abstracted in L'Agric. Colon., Florence, **14**(7): 314–315, July 1920 under the title "Un insetto molto dannoso al cocco in Portorico," according to Rev. Appl. Ent. **8**: 451.)

Brief general account with control.

Crespo, M. A. and **Catoni, L. A.** 1920. Restricciones legales al comercio de plantas en Puerto Rico. Est. Exp. Ins. Circ. **27**: 1–18.

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Anthophora krugii and *Melissodes trifasciata* as new species from Puerto Rico.

Cresson Jr., E. T. 1930. Notes and descriptions of some neotropical Neriidae and Micropezidae. Trans. Am. Ent. Soc. **56**: 350.

Taeniaptera (=*Calobata*) *lasciva* Fab. recorded from several localities in Puerto Rico.

Crossman, S. S. and **Wolcott, G. N.** 1915. Cómo dominar la changa. Est. Exp. Asoc. Prod. Azúcar P. R. Circ. **6**: 1–5. Also an English Edition.

Control measures for the changa or West Indian mole cricket.

Cuevas Zequeira, L. 1925. Apicultura. Rev. Agr. P. R. **15**(5): 229–230. Notes on beekeeping in Puerto Rico.

Curran, C. H. 1926. New Diptera from the West Indes. Am. Mus. Novitates No. 220, 14 pp., June 19.

25 new species in 4 families described from Puerto Rico.

1927 *a*. New neotropical and oriental Diptera in the American Museum of Natural History. Am. Mus Novitates No. 245, 9 pp.

5 new species in 3 families described from Puerto Rico.

1927 *b*. New West Indian Tachinidae. Am. Mus Novitates No. 260, 15 pp., March 19.

4 new genera and 13 new species described from Puerto Rico.

1928. Insects of Porto Rico and the Virgin Islands. Diptera or two-winged flies. N. Y. Acad. Sci. Surv. P. R. and Virgin Ids. **11**(1): 1–118, 39 figs.

Records about 275 species from Puerto Rico, of which 16 are described as new; 1 new genus; a list is appended of species previously listed from Puerto Rico but not seen by the author.

1930. New species of Diptera belonging to the genus *Baccha* Fabricius (Syrphidae). Am. Mus. Novitates No. 403, 14 pp., February 28.

Baccha deceptor as a new species from Puerto Rico, St. Thomas and St. Croix.

1931 *a*. First supplement to the Diptera of Puerto Rico and

the Virgin Islands. Am. Mus. Novitates No. 456, 23 pp., 4 figs.

1 new genus and 9 new species included in a number of additions to the list for the Island.

1931 *b*. New species of *Chrysopilus* from the neotropical region (Rhagionidae, Diptera). Am. Mus. Novitates No. 462, pp. 4 and 7, March 17.

Chrysopilus macularis and *C. leonardi* as new species from Puerto Rico.

Danforth, R. E. 1924. Notes on the life history of *Disonycha laevigata* Jacoby in Porto Rico Jour. Econ. Ent. **17**(3): 415–416.

The duration and description of the stages are given for the first time.

Danforth, S. T. 1926. Birds of the Cartagena Lagoon, Porto Rico. Jour. Dept. Agr. P R **10**(1): 1–136, 45 figs.

Contains many observations on insects eaten

1928. El departamento de zoología y entomología [del Colegio de Agricultura e Ingeniería de la Universidad de Puerto Rico] Rev Agr. P R **20**(5): 230 and 245, 1 fig.

Brief account of the plan of instruction in zoology and entomology.

1929. Entomology. Agr Ext Leaflet 4, Col. Agr. and Eng. Univ. P. R., 11 pp

Brief general statement of the subject, with special reference to Puerto Rico.

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Dewitz, H. 1877 *a*. Tagschmetterlinge von Portorico, gesammelt von Herrn Consul Krug. Stett. Ent. Zeit. **38**: 233–245, 1 pl.

The earliest paper on Puerto Rican butterflies, with descriptions of new species and varieties.

1877 *b*. Dämmerungs—und Natchtfalter von Portorico, gesammelt von Herrn Consul Krug. Mitteilungen des Münchner Ent. Vereins **1**: 91–96, pl. 1.

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A brief record of the results obtained in a demonstration in the control of ants in a tobacco seed bed.

Dikmans, G. 1927 *a*. Report of the parasitologist. P. R. (Mayagüez) Agr. Exp. Sta. for 1925, 22–24.

The horn fly taken on animals from the dry section and larvae of *Hypoderma* found in imported cattle.

1927 *b*. Report of the parasitologist. P. R. (Mayagüez) Agr. Exp. Sta. Rept. for 1926, pp. 30–31.

Note on baby chicks infested with the sticktight flea, *Echidnophaga gallinacea*, and notes on lice on cattle and goats.

1929. Report of the parasitologist. P. R. (Mayagüez) Agr. Exp. Sta. Rept. for 1927, pp. 27–28.

Several external parasites of domestic animals and poultry recorded.

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Phanurus flavus from the eggs of *Ormenis pygmaea* Fab. from Puerto Rico.

Dohrn, Anton. 1860. Beiträge zu einer monographischen Bearbeitung der Familie der Emesina (part 2). Linn. Ent. **4**: 226–227.

Emesa varicornis and *Westermannia tenerrima* as new from Puerto Rico.

1863. Same title as above (part 2). Linn. Ent. **5**: 226–227.

Westermannia tenerrima Dohrn redescribed at greater length from Puerto Rico.

Dozier, H. L. 1925. An outbreak of the red-striped sugar-cane scale. Jour. Dept. Agr. P. R. **9**(4) : 357–367, 4 figs.

Description of the various stages and notes on the parasites; *Cheiloneurus pulvinariae* is described as a new species, hyperparasite on *Aphycus flavus* How.

1926 *a*. Some new Porto Rican scale parasites (Hymenoptera, Encyrtidae). Proc. Wash. Ent. Soc. **28**(5) : 97–102, 4 figs.

Mercetiella reticulata as a new genus and species and *Euaphycus portoricensis*, new species from *Asterolecanium pustulans* and *Acerophagus nubilipennis*, new species, from *Pseudococcus adonidum* and *P. citri*.

1926 *b*. Some new and interesting Porto Rican leafhoppers. Jour. Dept. Agr. P. R. **10**(3 and 4) : 259–265 (Date of publication, Sept. 1927).

Seven species described of which 3 are new.

1926 *c*. Notes on Porto Rican scale parasites. Jour. Dept. Agr. P. R. **10**(3 and 4) : 267–277.

Thirteen species treated of which 2 are new, the remainder mostly re described.

1926 *d*. Notes on Porto Rican Thysanoptera. Jour. Dept. Agr. P. R. **10**(3 and 4) : 279–281.

Locality and food plant notes on 9 species, of which apparently 5 had not before been recorded from Puerto Rico—*Franklinothrips vespiformis* Cwfd., *Aleurodothrips fasciapennis* Fkln., *F. tritici* Fitch, *Haplothrips merrilli* Watson and *Hoplandrothrips reyneri* Priesner.

1926 *e*. Annual report of the division of entomology. Ann. Rept. Ins. Exp. Sta. P. R. for 1924–1925, pp. 115–124.

Notes on the status of various injurious insects.

1927 *a*. An undescribed white fly attacking citrus in Puerto Rico. Jour. Agr. Res. **34**(9) : 853–855, 3 figs.

Describes all stages of *Paraleurodes naranjae* and records 61.2% of the pupae as parasitized by *Encarsia variegata* How.

1927 *b*. A new Fulgorid from Puerto Rico. Jour. N. Y. Ent. Soc. **35**(1) : 53–54, 2 figs.

Rhynchopterx salina from Guánica, Feb., 1925, on *Batis maritima*, "Lirio de mar."

1931. New and interesting West Indian Homoptera. Am. Mus. Novitates No. 510. 24 pp., 18 figs.

New species from Puerto Rico: *Nessorhinus graciloides* (Membracidae); *Thionia borinquensis, Colpoptera maculata, Neocolpoptera* (new genus) *portoricensis* and *N. monticolens* (Fulgoridae)

1932 *a*. Descriptions of new Trichogrammatid (Hymenoptera) egg-parasites from the West Indes. Proc. Ent. Soc. Wash. **34**(3): 36–37.

Ufens osborni from the eggs of *Diaprepes spengleri abbreviatus* L. from Aguirre, P. R.

1932 *b*. The identity of certain whitefly parasites of the genus Eretmocerus Hald., with descriptions of new species (Hymenoptera: Aphelininae). Proc. Ent. Soc. Wash. **34**(7): 112–118, 1 fig.

E. portoricensis as a n. sp. from *Aleurothrixus floccosus* Maskell at Bayamón and Central Aguirre, P. R. in 1925. Stated that this is the species erroneously determined for the writer as *E. californicus* and recorded as an efficient parasite of the woolly whitefly in Ins. Exp. Sta. Circ. P. R. 88.14, 1925.

1932 *c*. Two undescribed chalcid parasites of the woolly whitefly, Aleurothrixus floccosus (Maskell), from Haiti. Proc. Ent. Soc. Wash. **34**(7): 118–122.

Euderomphale aleurothrixi n. sp. from many males and females from Haiti; a single female from the same lot at Central Aguirre, P. R., is thot to be undoubtedly the same species altho the general color is a shade deeper.

Drake, C. J. 1918. Two new Tingids from the West Indies (Hem.—Heter.). Ohio Jour. Sci. **18**(5): 174–175.

Leptodictya bambusae from Puerto Rico.

Dyar, H. G. 1907. Descriptions of some American mosquitoes. Jour. N. Y. Ent. Soc. **15**: 13.

Culex lowii Dyar & Knab is described as new from P. R. (=*Culex secutor* Theobald).

1922. New American moths and notes (Lepidoptera). Ins. Insc. Men. **10**(1–3): 10–11.

Agripodes jucundella (Noctuidae) from Puerto Rico.

1924. The male of Anopheles vestipennis Dyar & Knab (Diptera, Culicidae). Ins. Insc. Men. **12**(10): 171.

Described from Puerto Rico.

1928. The mosquitoes of the Americas. Carnegie Institute Pub. No. 387, 616 pp., 418 figs.

All species known to occur in Puerto Rico to date are redescribed.

Earle, F. S. 1920. The cultivation of citrus fruits in Porto Rico. Ins. Exp. Sta. Circ. **26**: 16–17.

Brief discussion of insect pests.

1928. Sugar-Cane and Its Culture (Chapt. 6 "Insect and Other Pests of Sugar-Cane" pp. 162–188, refs. 22.) pp. 355, fig. 24, John Wiley and Sons, New York.

Earle, W. C. 1925 *a*. Malaria surveys in Porto Rico. P. R. Health Rev. **1**(4): 12–18, October.

In part this is a brief report on the malaria survey made 1919; it is stated that "*Anopheles albimanus* would easily appear to be the most important vector, altho at certain seasons *Anopheles grabhami* and *vestitipennis* are quite abundant.

1925 *b*. The relation of irrigation on cane fields to the malaria problem. Agr. Notes P. R. (Mayagüez) Agr. Exp. Sta., Office of Farm Management, No. 21, 3 pp., 1 diagram.

Incidence of malaria, breeding places for Anopheline mosquitoes and management of irrigation ditches discussed

*1926. Cane field irrigation and malaria. Sugar (Review) **28**: 384, New York, August.

Listed in Pedreira's Bibliographia Puertorriqueña, p. 115, but I have been unable to consult a copy of this volume of Sugar to ascertain its exact contents.

1930. Malaria in Porto Rico. Am. Jour. Trop. Med. **10(3)**: 207–230, 8 refs.

A good account of the situation; the 3 species of *Plasmodium* and the 3 species of *Anopheles—albimanus, grabhami, vestitipennis* discussed in relation to the disease.

1932. Notes on the life-history of *Anopheles albimanus* and *grabhami*. P. R. Jour. Pub. Health and Trop. Med. **7**: 381–384.

1933. Some observations of antimosquito screening and screening materials. To be published in the March number of the P. R. Jour. Publ. Health & Trop. Med., Vol. 8

Earle, W. C. and Arbona, Antonio. 1930. La malaria en Puerto

Rico. Oportunidad que se ofrece a los cañeros como de las mayores entidades que pueden coadyudar a su restricción. Rev. Agr. P. R. **24**(12): 235–239.

A general discussion of work both done and to be done in an effort to reduce malaria, especially in the South Coast sugar growing sections, by means of proper location of workers' colonies, drainage, etc., in order to reduce the possibilities of transmission by mosquitoes.

Erichson, G. F. 1839–1840. Genera et species Staphylinorum insectorum coleopterorum familae, pp. 79–910.

Included within the range of the above cited pages are 26 species distributed in 19 genera described as new from Puerto Rico.

Erichson, G. F. in Germar, E. F. 1843. Versuch einer systematischen Eintheilung der Nitidularien. Zeit. für die Ent. **14**: 245.

Colastus infimus Er. as a new species from N. Am., Puerto Rico and Brazil (=*Colopterus truncatus* Randall).

Fauvel, Albert. 1895. Notes synonymiques. Rev. d'Ent., **14**: 106.

Olibrus parki var. *erithacus* Chevr. mentioned as occurring in Puerto Rico (as *Euxestus erithacus*).

Faxon, Richard and **Trotter, C. P.** 1932. Plant quarantine service in Porto Rico. Jour. Econ. Ent. **25**(3): 435–447.

A detailed historical account with notes on the principal insects quarantined against and on the more important species injurious to several of the leading crops.

Felt, E. P. 1913. Three new gall midges (Diptera). Can. Ent. **45**(9): 304–305.

Karschomyia cocci and *Mycodiplosis insularis* described from Puerto Rico.

1914. Arthrocnodax constricta n. sp. Jour. Econ. Ent. **7**(6): 481.

Reared from garden beans & probably predaceous on *Tetranychus bimaculatus*, T. H. Jones Coll., Río Piedras.

1932. A new cambium miner of citrus in Puerto Rico. Jour. Dept. Agr. P. R. **16**(2): 117–118.

Asynapta citrinae reared by G. N. Wolcott at Isabela, 1931.

Fernald, Mrs. M. E. 1903. A catalogue of the Coccidae of the world, Amherst, Mass., pp. 259–260.

Aspidiotus forbesi listed as occurring in Puerto Rico.

Fernández de Oviedo, Gonzalo. 1535. Historia general y natural de las Indias.

Fifty volumes published of which Book 16 and some chapters of others relate to Puerto Rico; included in the Biblioteca Histórica de Puerto Rico by Tapia, which see.

Ferris, G. F. 1922. Notes on Coccidae IX. Can. Ent. **54**(7): 160–161, fig. 4.

Cryptostigma (*Pseudophillipia*) *inquilina* on *Inga laurina* described from Puerto Rico as *C. ingae* new species.

[**de la Ferté-Senectere, M. F.** 1848. Monographie des Anthicus et genres voisins, coléopteres hétéromeres de la tribu des Trachélides. p. 157. Paris.

Wolcott on p. 85 of his "List" states that the type of *Anthicus vicinus* is given as "'America borealis' from Puerto Rico" but an examination of the original description does not show any mention of Puerto Rico or any such definite locality.]

Figueroa, C. A. 1924. Demonstraciones Agrícolas. P. R. Dept. Agr. y Trab., Div. Fomento Circ. 3, pp. 1–65, several figs.

Notes on demonstrations in the control of the sweet potato weevil, *Cylas formicarius*, pp. 20–25 on tobacco insects, pp. 26 28, 30 on the changa, *Scapteriscus vicinus*, p. 29, on onions and on tobacco, p. 31, and on insects affecting stored seeds, pp. 32–36.

1926 *a*. Demostraciones agrícolas, 1924–25. Represión de enfermedades y plagas. Dept. Agr. y Trab. P. R. Circ. de Fomento No. **7**: 107–138.

This chapter outlines methods and results of a number of demon strations in the practical control by the official Agricultural Agents of a number of the more important crop pests in the Island.

1926 *b*. Algunos problemas agrícolas de Puerto Rico y sus soluciones. P. R. Dept. Agr. y Trab., Div. Fomento, Circ. 8, pp. 1–32, several plates.

Notes on demonstrations on the control of the sweet potato weevil, *Cylas formicarius*, the banana root-weevil. *Cosmopolites sordidus*, and the cattle tick.

Fischer, von W. G. 1888. Drei neue Anthonomus. Berl. Ent. Zeitschr. **32**(2): 487–489.

Anthonomus krugii, *A. nigrovariegatus* and *A. annulipes* described from Puerto Rico.

Fisher, W. S. 1918. Chrysobothris tranquibaricus Gmel. ver-

sus impressa Fabr. (Coleoptera, Buprestidae). Proc. Ent. Soc. Wash. **20**(8): 174 and 176.

Chrysobothris fraterna Mann described from Puerto Rico in Bul. Soc. Imp. Moscou 10(8): 75–76, 1837 is listed as a synonym.

1925 *a*. A revision of the West Indian Coleoptera of the family Buprestidae. Proc. U. S. Nat. Mus. Vol. **65**, Art. 9(2522): 1–207.

Acmaeodera gundlachi, p. 45, *Chrysobothris wolcotti*, p. 119, and *Taphrocerus elegans*, p. 187 described as new species from Puerto Rico.

1925 *b*. New West Indian Cerambycidae (Coleoptera). Subfamily Lamiinae. Am. Mus. Novitates No. **174**, 16 pp., May 28.

Leptostylus gundlachi and *L. antillarum* as new species from Puerto Rico.

1926. Descriptions of new West Indian longicorn beetles of the subfamily Lamiinae. Proc. U. S. Nat. Mus. Vol. 68, Art. 22(2623): 15–16.

Leptostylus longicornis as a new species from the Ins. Exp. Sta., Río Piedras, P. R.

1930 *a* Notes on the rhinotraginae beetles of the family Cerambycidae, with descriptions of new species. Proc. U. S. Nat. Mus. Vol. 77, Art. 19(2842): 1–20.

Acyphoderes aurulenta Kirby recorded from Puerto Rico is probably the species recorded as *abdominalis* by Gahan and by Leng & Mutchler and mentioned in Wolcott's "List".

1930 *b*. New West Indian Buprestidae (Coleoptera). Proc. Wash. Ent. Soc. 32(7): 128–129.

Neotrachys hoffmani described from Puerto Rico.

1932. New West Indian Cerambycid beetles. Proc. U. S. Nat. Mus. 80 (Art. 22): 1–93.

Brittonella (new genus) *chardoni*, *Eburia portoricensis*, *Euaphidion portoricensis*, *Stizocera vanzwaluwenburgi*, *Tilloclytus minutus*, *Lamproclytus elegans* (new genus), and *Ecyrus nanus* and *E. flavus* described as new from Puerto Rico.

Fletiaux, Ed. 1897. Liste des Eucnemidae du musée de Berlin et description des espéces nouvelles. Ann. Soc. Ent. Belgique **41**: 256.

Arrhipis lanieri Guer. listed from Puerto Rico.

Folsom, J. W. 1923. A new Lepismid from Puerto Rico. Proc. Ent. Soc. Wash. **25**(7–8): 169–170, pl. 14, figs. 1–8.

Ctenolepisma reducta.

1927. Insects of the Subclass Apterygota from Central America and the West Indies No. 2702. Proc. U. S. Nat. Mus. Vol. 72, art. 6, pp. 1–16 pl. 8.

Salina wolcotti and *Lepidocyrtus nigrosetosus* described.

Forbes, W. T. M. 1917. Notes on West Indian Syntomidae and Arctiidae (Lepidoptera). Bul. Am. Mus. Nat. Hist., Art. 14, **37**: 339–345.

Lymire senescens as a new species (= *L. flavicollis* DeW.) from Puerto Rico; *Eunomia columbina* (F.) recorded from Puerto Rico; variation in *Utetheisa ornatrix* L. is discussed.

1930. Insects of Porto Rico and the Virgin Islands. Heterocera or moths (excepting the Noctuidae, Geometridae and Pyralidae). N. Y. Acad. Sci. Surv. P. R. and the Virgin Ids. **12**(1): 1–171, 2 pls.

One hundred seventy-four species are treated, mostly Puerto Rican, of which 6 new species and 1 new race are described from Puerto Rico; keys to the families, genera and species are given.

1931. Supplementary report on the Heterocera or moths of Puerto Rico. Jour. Dept. Agr. P. R. **15**(4): 339–394, 6 pls.

Four new genera and 37 new species included. Also reprinted without change of title or pagination as a supplement to the preceding title.

1932. The rubidella group of Aristotelia. Jour. N. Y. Ent. Soc. **40**(4): 423–433.

Aristotelia diolcella and *A. vagabundella* mentioned as having been described from Puerto Rico.

Forbes, W. T. M. and **Leonard, M. D.** 1930. A new leaf-miner of cotton in Porto Rico. Nepticula gossypii new species. Jour. Dept. Agr. P. R. **14**(3): 151–157, 2 pls.

Distribution, life-history, description of stages, nature of injury and suggestions for control.

Frost, S. W. 1931. New species of West Indian Agromyzidae (Diptera). Ent. News **42**: 74–75.

Agromyza ipomeae described as a leaf-miner of sweet potato in Puerto Rico.

Funkhouser, W. D. 1930. New genera and species of neotropical Membracidae. Jour. N. Y. Ent. Soc. **38**: 413–414, pl. 23, fig. 12.

> ***Spinodarnoides typus*** described as a new genus and species from Puerto Rico.

Gahan, A. B. 1915. Descriptions of new genera and species, with notes on parasitic Hymenoptera. Proc. U. S. Nat. Mus. **48**: 1–165.

> ***Diaulinus insularis*** (Eulophidae) described from Puerto Rico as parasitic on ***Agromyza inaequalis*** Malloch.

1927. Miscellaneous descriptions of new parasitic Hymenoptera with some synonymical notes. Proc. U. S. Nat. Mus. **21** (Art. 4, No. 2676) 1–39, 1 pl., 3 figs., 8 refs.

> ***Prospaltella ciliata*** described as a new species from ***Aleurodicus*** sp. in Puerto Rico.

1930. Synonymical and descriptive notes on parasitic Hymenoptera. Proc. U. S. Nat. Mus. Vol. **77** (Art. 8, No. 2831): 1–11.

> *Telenomus sphingis* Ashm. reared from the eggs of ***Phlegethontius sexta*** Joh. by W. V. Tower at Gurabo, P. R., (previously determined by J. C. Crawford as *T. monilicornis*).

1932. Miscellaneous descriptions and notes on parasitic Hymenoptera. Ann Ent. Soc. Am. **25** (4): 736–757.

> *Apanteles laevigatus* Asm. mentioned as occurring in Puerto Rico, p. 737 and ***Grotiusomyia nigricans*** How, recorded as received thru the P. Q. & C. A. bred from (*Lamprosema*) *Hedylepta indicata*, the bean leaf webber, from Puerto Rico.

Gahan, C. J. 1895. On the longicorn Coleoptera of the West India Islands. Trans. Ent. Soc. London, pp. 79–140, 2 pls.

> A number of Puerto Rican records including ***Eburia bindosa*** as a new species from Puerto Rico. This is possibly a synonym of ***E. quadrimaculata*** L.

Gerstaecher, Carl E. A. 1860. Die Arten der Gattung Lissomus Dalm. Linn. Ent. **14**: 169.

> ***Drapetes chalybaeus*** described as a new species from Puerto Rico (as ***Lissomus***).

Gibson, E. H. 1917. Two new species of Dicyphus from Porto Rico. Can. Ent. **49** (6): 218–219.

> ***D. prasinus*** and ***D. luridus.***

Girault, A. A. 1916. Descriptions of miscellaneous chalcid-flies. Insec. Inscit. Men. **4**(11–12) 111–113.

Eurytoma ctenodactylomyii and *Neocatolaccus livii* as new species from Puerto Rico

Gómez, J. C. 1928 La vaquita de la caña. Rev. Agr. P. R. **20**(5) : 238 and 256.

Brief popular account of *Diaprepes spengleri* in Puerto Rico

González, Manuel. 1924 Resultados obtenidos en una demonstración cuyo propósito fué controlar la changa y el gusano prieto del tabaco en una plantación Rev Agr P R **13**(6) · 403

González Ríos, Policarpo. 1920. Cultivo del banano en Puerto Rico Est Exp Ins P R Bol **25**, 27

Brief note on injury of *Phyllophaga* and *Diaprepes* injury to the banana in Puerto Rico, stated that insects are not very injurious

1921 El cultivo del cocotero en Puerto Rico Ins Exp Sta P R Circ **35**: 1–20. 4 figs

The insect enemies of the coconut in Puerto Rico include the scales *Aspidiotus destructor* and *Vinsonia stellifera* and the rhinoceros beetle *Strataegus quadrifoveatus*, brief account with control

1922 El gorgojo de banano Rev Agr P R **9**(6) 39–42

Brief popular account of the banana root weevil, *Cosmopolites sordidus*, in Puerto Rico

1923 El gusano del cogollo de la yuca Rev Agr P R **10**(4) 45–46

Brief popular account of the cassava or yuca shoot borer, *Lonchaea chalybea* Wied in Puerto Rico

1930 Cultivo del banano en Puerto Rico Est Exp Ins P R Bol **36**: 47–51

Brief discussion of the root weevil and other insects attacking the banana in Puerto Rico with suggestions for control

González Ríos, P. and **Mayoral Reinat, A.** 1931. El cultivo del aguacate en Puerto Rico Est Exp Ins P R Circ **93**: 30–31

Brief account of the more important insects affecting the avocado in Puerto Rico

Gould, H. P. 1904. Indicaciones prácticas sobre el cultivo de frutas. Dept Int P. R, Neg Agr. y Minas, Bol Agr **19**, pp. 5–22.

A Spanish translation of U. S. Farmers' Bul. 161 "Practical suggestions for fruit growers," 1902. This contains a discussion of spraying for the control of insects and diseases and descriptions of special uses of the various types of spray machines

Gundlach, Juan. 1887, 1891 and 1894. Apuntes para la fauna Puerto-Riqueña Ann. Soc. Espan. Hist. Nat. 16, 20 and 22. Part 8 of the whole deals with insects starting on p. 137 of Vol **16** with the various orders as follows:
1887. Vol. **16**. 139–150, Orthoptera; 150–174; Hymenoptera; 174–199, Diptera.
1891. Vol. **20**: 323–384, Lepidoptera.
1894 Vol. **22**: 261–273, Neuroptera (incl. Odonata); 274–287, Hemiptera, 287–344, Coleoptera.

No new species are described but many scattered biological notes are included.

de Haan, Willem. 1842. Bijdragen tot de Kennis der Orthoptera. Verhand de Natur Gesch der Nederl Overzeesch Bezitt etc., Orthoptera, p. 102. Leiden

According to Wolcott's "List" on p 23 *Bacteria calamus* (Phasmidae) is described from Puerto Rico as a new species I fail to find any mention of this species in this work *B spinosus* Burm is, however, listed from Puerto Rico

Hall, Maurice. 1929 Parásitos del ganado en América Latina. Rev Agr P R **22**(8) · 56 and (9): 117

A general account of the principal external and internal parasites of animals in Latin America, including control measures, several of of the more important insect pests such as cattle ticks, and the horn fly of cattle are briefly mentioned on p 60 specifically as being troublesome in Puerto Rico

Hampson, Geo. F. 1898–1920 Catalogue of the Lepidoptera Phalaenae in the British Museum 13 Vols and 2 Suppls

The above are all that have been published to date and include the Syntomidae, Arctiidae, Agaristidae (only 1 species in Puerto Rico), and Noctuidae, (in part, about two thirds) There are descriptions of many species specifically stated as occurring in Puerto Rico

Harris, H. M. 1928. A monographic study of the hemipterous family Nabidae as it occurs in North America Ent. Am **9** (N.S.) (1 and 2): 77–78.

Carthasis gracilis Harris listed from Puerto Rico.

Hebard, Morgan. 1916. Studies in the group Ischnopterites.

(Orthoptera, Blattidae, Pseudomopinae). Trans. Am. Ent. Soc. **42**(4): 367, pl. XVIII, figs. 14–17.

Symploce flagellata as a new species from Puerto Rico (Blattidae).

Henricksen, H. C. 1906 *a*. Vegetable growing in Porto Rico. P. R. (Mayagüez) Agr. Exp. Sta. Bul. **7**: 18–20, 2 figs.

A brief general account of insect pests: two classes of insects-biting and sucking affecting vegetables; the formulae for several of the standard insecticides are given and two types of small sprayers are suggested.

1906 *b*. Report of the horticulturalist. Insect pests. P. R. (Mayagüez) Agr. Exp. Sta. Rept. for 1905, pp. 27–28.

Brief notes on several scales, June beetles, and ants with suggestions for control

1930. Citrus culture in Porto Rico P. R (Mayagüez) Agr. Exp Sta. Bull. **33**: 27–30.

A brief general account of the more important citrus insects and their control

Henricksen, H. C. and **Iorns, M. J.** 1909. Pineapple growing in Porto Rico P. R (Mayagüez) Agr. Exp. Sta. Bul. **8**, p. 38.

The mealybug, *Pseudococcus brevipes* Ckll., and its attendant ant are mentioned; tobacco dust is recommended

Hernández, Elías 1925 Represión del pulgón amarillo de la caña. Resultado de las demostraciones Nos 12 y 13 (Contribución de la División de Fomento Agrícola) Rev. Agr P. R. **14**(6): 358–360

Notes on a demonstration for the control of the yellow cane aphis, *Sipha flava*, with nicotine dust at San Germán

Hernández, Elías and **Ramírez López, Carlos.** 1925 Represión de la oruga de la hoja del algodón Demostración No. 3. (Contribución de la División de Fomento) Rev. Agr P R **14**(1): 43–44.

Better results obtained in the control of the cotton leafworm by arsenate of lead dust than by spray.

Herrera, Antonio de. (1565–1625) Historia general de las Indias.

This work comprises 8 "decadas" the first to the fifth referring to Puerto Rico. Decada 2, libro 3, chapter 14, pp. 110–112, year 1518 refers to the ant plague in Hispaniola (Santo Domingo) and in San Juan, Puerto Rico, and the remedy therefore.

Hinds, W. E. 1903. El bisulfuro de carbono como insecticida. Dept. Interior. P. R. Neg. Agr. y Minas, Bol. Agr. **17**: 19–40. San Juan, November.

A translation of U. S. Farmers' Bul. 145, 1902 on "Carbon bisulfid as an insecticide.

Hoffman, Wm. A. 1925. A review of the species of Culicoides of North and Central America and the West Indies. Am. Jour. Hygiene **5**(3) · 285–289.

C. phlebotomus Will. and *C. furens* Poey recorded from Puerto Rico.

1927. A container for field collection of mosquito larvae. Science **66**: 484, 1 fig.

Description and diagram of the container.

1932. *Icerya purchasi* in Puerto Rico. Jour. Econ. Ent. **25** (3): 726.

Brief note of its occurrence on casuarina (Australian pine) in San Juan proper.

Hoffman, W. A., Marín, R. A. & Burke, A. M. B. 1928. Filariasis in Porto Rico. P. R. Rev. Pub. Health & Trop. Med. **4**(3): 120–127, 1 map. (Abs. in Rev. Appl. Ent. B **17**: 115).

Preliminary results of surveys in 31 localities, *Culex fatigans* found in all localities examined but scarcer in higher altitudes.

Holloway, T. E. 1915. Fighting the sugar-cane borer with parasites and poisons. Reprint from the Louisiana Planter and Sugar Manufacturer, December 18

Reference is made to Wolcott's observation that borer infestation in Puerto Rico is inversely proportional to the amount of rainfall.

Holloway, T. E., Haley, W. E. and Loftin, U. C. 1928. The sugar-cane moth borer in the United States. U. S. Dept. Agr. Tech. Bul. **41**, 76 pp., 1 pl. and 25 figs.

Several references are made to *Diatraea saccharalis* Fab. in Puerto Rico.

Holloway, T. E. and Loftin, U. C. 1919. The sugar-cane moth borer. U. S. Dept. Agr. Bul. **746**, 74 pp., 9 pls., 12 figs.

On pp. 35–36 Wolcott's observations in Puerto Rico on rainfall and borer abundance are again referred to.

* **Holmer, E. and Little, L. L.** 1921. Porto Rico, beehive and orchard. Travel **36**: 22, January, New York.

Hood, J. D. 1913 *a*. Two new Thysanoptera from Porto Rico. Insec. Inscit. Men. **1**(6): 65–70, 1 pl.

Heterothrips sericatus as a new species and *Podothrips semiflavus* as a new genus and species from Puerto Rico.

1913 *b*. On a collection of Thysanoptera from Porto Rico. Insec. Inscit. Men. **1**(12): 149–154, 1 pl.

Dinurothrips hookeri as a new genus and species from Puerto Rico.

1914. Two Porto Rican Thysanoptera from sugar cane. Insec. Inscit. Men. **2**(3): 38–41.

Heliothrips (?) *tibialis* as a new species and notes on *H. femoralis* Reuter. These are both in Wolcott's "List" on p. 239 under *Haplothrips.*

Hooker, C. W. 1912. The Ichneumon flies of America belonging to the tribe Aphioninae. Trans. Am. Ent. Soc. **38**: 144, pl. II, fig. 13.

Eremotylus angulatus as a new species from Puerto Rico.

1913 *a*. Report of the entomologist. P. R. (Mayagüez) Agr. Exp. Sta. Rept. for 1912, pp. 34–38.

Notes on insect pests of coffee, mango, citrus and sugar cane and on apiculture; distribution of two Coccinellid beetles—*Cryptolaemus montrouzeri* from Río Piedras to Mayaguez and *Hippodamia convergens* introduced from California also of the occurrence of the papya fruit fly, *Toxotrypana curvicauda* at Mayagüez.

1913 b. Entomological conferences in Porto Rico. Jour. Econ. Ent. **6**: 148–150.

A brief report on two conferences of the workers in entomology in Puerto Rico; an annotated list is given of the 9 papers read at the second conference, presented by as many individuals, which summarize the progress on several of the major projects under investigation.

Hottes, F. C. and **Frison, T. H.** 1931. The plant lice, or Aphiidae, of Illinois. Bol. Div. Nat. Hist. Surv. Ill. **19**, Art. 3, p. 174.

Sipha flava Fbs. stated as being frequently a serious pest of young sugar cane in Puerto Rico.

Howard, L. O. 1930. A history of applied entomology. (Somewhat Anecdotal). Smithsonian Miscl. Coll. **84** (Whole Volume), Publ. 3065, pp. 457–460 and 523.

A brief resumé of applied entomology in Puerto Rico on pp. 457–460: on p. 523 are brief notes on parasite introductions.

Howard, L. O., Dyar, H. G. and Knab, Fred. 1912–1917 Mosquitoes of North and Central America and the West Indies. Carnegie Institute of Washington Publ No 159, **1** 1–520, 1912, **2**, 150 pls of 711 figs, 1912, **3** 1–523, 1915 **4** 524–1064, 1917

All the species, old and new, known to occur in the territory covered, including Puerto Rico, are herein described

Hutson, J C. 1917 *a* Some weevils of the genus Diaprepes in the West Indies Agr News Barbados, B W I **61**(398) · 186

Diaprepes doublieri, spengleri and *abbreviatus* listed as occurring in Puerto Rico

1917 *b* White grubs injuring sugar cane in Porto Rico Agr News, Barbados, B W I **16**(397) 218–219 (398) 234 (399) 250–251

The paper by E G Smyth on white grubs injurious to cane in Puerto Rico in Jour Dept Agr P R 1(2), 1917 is abstracted at some length

1917 *c* Sugar cane white grubs in Porto Rico Agr News, Barbados B W I **16**(404) 330–331

Abstract of the continuation of the above paper by Smyth in Jour Dept Agri P R 1 3) 1917

Iches, M Lucien Date? La abeja domestica p 368

Colon J D 1930 in foot note No 6 on page 158 says that it is here stated that the first bees imported into Puerto Rico and Cuba were *Apis mellifica* but that later there were imported into North America the Italian and Egyptian races

Illiger, J. C W 1807 Monographie der Elateren mit leuchtenden Flecken auf dem Halsschilde Mag Gesellschaft Nat Freund Berlin 1 p 149

Pyrophorus luminosus described as a new species from Puerto Rico

Jacoby, Martin. 1888 Biol Centr Am Coleoptera, **6**, Pt 1, pp 616–617

Cerotoma ruficornis Oliv listed from Puerto Rico

Javiere, Clemente. 1932 Enfermedades y plagas que atacan al plátano Bol Agr (P R) No **30**, p 3, March 5

Brief note on injury and control of the banana root weevil, *Cosmopolites sordidus*

Johnson, H. A. 1926. Occurrence of *Anopheles vestipennis* in Porto Rico. Am. Jour. Trop. Med. **6**(2): 153–155.

First record of larva and adult male obtained during investigations in 1924–1925 with notes on seasonal abundance of the species.

Johnston, J. R. 1915. The entomogenous fungi of Porto Rico. Bd. Comm. Agr. P. R. Bul. **10**, 33 pp., 9 pls.

Descriptions of the species known to be present with notes on them and on the insects which they are known to parasitize in Puerto Rico.

Jones, T. H. 1913. Some notes on Laphygma frugiperda S. & A. in Puerto Rico Jour Econ. Ent. **6**(2): 230–236.

1914. Additional notes on Porto Rican sugar-cane insects. Jour. Econ. Ent. **7**:(6)461–463.

Brief notes on determinations of specimens by various specialists and on synonomy of several species.

1915 *a*. Aphides or plant-lice attacking sugar-cane in Puerto Rico. Bd. Comm. Agr. P. R. Bul. **11**, 19 pp., 2 figs

1915 *b*. La mariposa-barreno del tallo de la caña de azúcar (Diatraea saccharalis Fabr.). Junta de Com. Agr. P R Bol. **12**, 31 pp., 6 figs.

1915 *c*. The sugar-cane weevil root-borer (*Diaprepes spengleri* L.). Bd. Comm. Agr P. R. Bul. **14**: 1–19, 11 figs

1915 *d*. Insects affecting vegetable crops in Porto Rico U S. Dept. Agr. Bul. **192** (professional paper), 11 pp., 4 pls

General account of more important species concerned with control measures.

1917 *a*. A list of the Coccidae of Porto Rico Jour. Dept Agr. P. R. **1**(1): 1–16, 26 references.

Notes on the food plants and distribution of 50 species are given.

1917 *b*. The sweet-potato leaf-folder. U. S. Dept Agr. Bul. **609**: 1–12, 4 figs.

Pilocrocis tripunctata F. mentioned on p 2 as injurious in Puerto Rico

Jones, T. H. and **Wolcott, G. N.** 1922. The caterpillars which eat the leaves of sugar cane in Porto Rico. Jour. Dept. Agr. P. R. **6**(1): 38–50, 10 figs.

Seven species of caterpillars do minor leaf-injury to sugar cane

leaves, of which notes and original observations are given for six of these.

J. R. 1923. Destrucción de los insectos por medio del petróleo. Rev. Agr. P. R. **11**(4): 19–21.

Brief general directions for the use of petroleum emulsions for the control of various groups of injurious insects.

Kellogg, Vernon L. 1905. American Insects, p. 161, fig. 230.

Mention made of the losses caused by the "changa" or Porto Rican mole cricket in Puerto Rico.

* **King, W. W.** 1917. The epidemic of dengue in Porto Rico, 1915. New Orleans Med. Surg. Jour. **49**(8): 564–71. (Abs. in Rev. Appl. Ent. Ser. B. **65**: 61.)

Culex and Aedes, the common mosquitoes in San Juan, were especially numerous at the time of the epidemic.

* **Kinman, C. F.** 1918. The mango in Porto Rico. P. R. (Mayagüez) Agr. Exp. Sta. Bul. **24**: 1–30, 11 pls.

A thrips and the fruit-fly, *Anastrepha fraterculus*, stated to be the only insects of importance; recommends enclosing fruits in paper bags for the control of the latter. (Abs. in Rev. Appl. Ent. 6: 392).

Klots, A. B. 1929. A revision of the genus Eurema Hübner. Ent. Amer. **9**(3), n. ser., p. 132, fig.

E. portoricensis Dewitz mentioned as occurring only in Puerto Rico.

Klots, Elsie Broughton. 1932. Insects of Porto Rico and the Virgin Islands. Odonata or dragon flies. N. Y. Acad. Sci. Surv. P. R. and the Virgin Ids. **14**(1): 1–107, 7 pls.

Thirty-eight species treated as occurring in Puerto Rico; none new.

Knab, Fred. 1915. Some West Indian Diptera. Insc. Inscit. Men. **3**(4): 48–49.

Tabanus hookeri as a new species from Mayagüez, 1 male and 1 female, collected by Van Zwaluwenburg.

Koch, C. 1842. Die Arachniden, **9**: 66–67, pl. cccx, fig. 732, 83–84, pl. cccxvii, fig. 744.

Mygale laeta, p. 66 and *Avicularia* (as *Mygale*) *caesia* as new species from Puerto Rico.

Kolbe, H. J. 1888. Die geographische verbreitung der Neuroptera und Pseudoneuroptera der Antillen nebst einer Übersicht über die von Herrn Consul Krug auf Portorrico gesammelten

Arten. Neuroptera v. d. Sammlung von Herr Krug. Archiv. für Naturgeschichte, 46th year, **1**(2): 153–178, pl. 13, 11 figs.

An important paper on Puerto Rican Neuroptera.

1907. Ueber die Arten der Amerikanischen Dynastidengattung Strataegus. Berl. Ent. Zeit. **51**(1906): 1–32, 1 pl., 8 figs.

S. quadrifoveatus on p. 21 and 32 and *S. titanus* on p. 31 listed from Puerto Rico..

1910. Ueber die Phileurinen Amerikas. An. Soc. Ent. Belgique **54**: 341.

Homophileurus quadrituberculatus P. de B. listed from Puerto Rico.

Kruger, Wilh. 1899. Das Zuckerrohr und seine Kultur mit besonderer Berücksichtigung der Verhaltnisse und Untersuchungen auf Java. p. 312.

In a foot-note *Delphax saccharivora* Westw. is listed from Puerto Rico

* **Kudo, R.** 1930. Studies on Micosporidia parasitic in mosquitoes. viii. On a Miscosporidian, *Nosema aedis* nov. spec., parasitic in a larva of *Aedes argenteus* (*aegypti*) of Puerto Rico. Archiv. Protistenk. **49**(1): 23–38, 2 pls., 47 refs. Jena, Jan. 15. (Notice by title in Rev. Appl. Ent. B 18: 87).

Lacordaire, J. T. 1845 Monographie des coléopteres subpentameres de la famille des Phytophages, Vol. I. Mem. Soc. Roy. Sci. Liege **3**: 355–356.

Lema polita described as a new species from Puerto Rico.

Langston, J. M. 1923. The tobacco leaf-folder of Porto Rico attacks tomatoes in Mississippi. Qtly. Bul. State Plant Bd. Miss. **2**(4): 7–9.

Notes on the discovery of *Pachyzancla periusalis* Wlk. in Miss. in Oct., 1922 and on its activities in Puerto Rico.

Lathy, P. I. 1899. Monograph of the genus *Calisto* Hübner. Trans. Ent. Soc. London, Part 2, pp. 221–228, pl. IV.

Calisto nubila described as a new species from Puerto Rico.

Ledru, Andrés Pedro. 1810. Viaje a la Isla de Puerto Rico en el año 1797. Paris. 2 Vols.

Forty-six species of insects listed from the Island. This is the earliest recorded collection of insects from Puerto Rico. Of those listed Wolcott indentifies 10 species in his ''List'' and states that the probable identity of many of the rest can be guessed.

* **Leefmans, S.** 1915. De cassave-oerets. [The cassava grubs]. Dept. Nijverheid, Landbow en Handel.—Med. van het Laboratorium voor Plantenzeikten, No. 13, 118 pp., 7 pls., 4 tables of curves. (Abstract in Rev. Appl. Ent. **4**: 82–84).

In the discussion of natural enemies reference is made to attempts which had been made to obtain beneficial parasites from Puerto Rico but which were unsuccessful.

Legrand, J. F. 1921. El gusano rosado del algodón (*Pectinophora gossypiella*). Rev. Agr. P. R. **7**(3): 9–13.

Brief general account of the pink bollworm.

1923. Notas de interés. Entomología. Rev. Agr. P. R. **10**(4): 49–50.

Notes on the sweet potato weevil and the cotton pink bollworm.

Leng, C. W. and **Mutchler, A. J.** 1914. A preliminary list of the Coleoptera of the West Indies as recorded to January 1, 1914. Bul. Am. Mus. Nat. Hist. **33** (Art. 30): 391–493.

Many species listed from Puerto Rico.

1916. Descriptive catalogue of West Indian Cicindelinae. Bul. Am. Mus. Nat. Hist. 35 (Art. 36): 681–699, pl. 1, 5 figs.

Five species occurring in Puerto Rico treated; none new.

1917. Supplement to preliminary list of the Coleoptera of the West Indies. Bul. Am. Mus. Nat. Hist. **37** (Art. 5): 191–220.

1922. The Lycidae, Lampyridae and Cantharidae (Telephoridae) of the West Indies. Bul. Am. Mus. Nat. Hist. **46** (Art. 8): 413–499, 65 figs.

Seven species described as new from Puerto Rico.

Leonard, M. D. (See also under Forbes 1930, Mills 1931, and Pemberton 1932).

1930 *a*. An unrecorded food-habit of the large tobacco suck-fly in Porto Rico. Jour. Econ. Ent. **23**(3): 640–641.

Brief note on injury to tobacco blossoms by *Dycyphus luridus* Gibson.

1930 *b*. A little-known root-weevil of cassava (*Coelosternus sulcatulus* Boehman). Jour, Dept. Agr. P. R. **14**(3): 159–165, 1 fig. and 3 pls.

Notes on injury and description of stages with a redescription of the adult of this rare weevil.

1930 *c*. Plagas de insectos de la cual está libre la caña en Puerto Rico. Rev. Agr. P. R. **25**(2): 62–63, 93–94.

A summary of the distribution, life history, injury and control of several important sugar cane insects not as yet occurring in Puerto Rico.

1930 *d*. Recomendaciones para combatir las plagas que afectan en Puerto Rico al cultivo del algodón. El Mundo (San Juan), Oct. 14, pp. 3, 9, 11. Reprinted under the same title in Rev. Agr. P. R. **25**(4): 135–136, 163–164. Also issued in mimeographed form by the Ins. Exp. Sta. as "Notas".

Suggestions for the control of the more important cotton insects in Puerto Rico.

1931 *a*. Entomology in Puerto Rico during the past decade. Jour. Econ. Ent. **24**(1): 141–151.

1931 *b*. *Leptoglossus gonagra* Fab. injuring citrus in Porto Rico. Jour. Econ. Ent. **24**(3): 765–767.

1931 *c*. A bibliography of the banana root weevil. Jour Dept. Agr. P. R. **15**(2): 147–176.

Two hundred fifteen titles annotated, on the world literature of *Cosmopolites sordidus*.

1931 *d*. Report of the division of entomology for the fiscal year 1929–30. Ann. Rept. Ins. Exp. Sta. P. R. for 1929–30, pp. 110–123.

Notes on insects of sugar cane, the banana root weevil, a citrus insect survey proposed, on cotton insects and silk worm culture; a brief insect pest survey for the year is included and cooperation with the Scientific Survey of P R & the Virgin Ids. as well as other projects referred to.

1931 *e*. Insect conditions in Porto Rico during the fiscal year ended June 30, 1930. Insect Pest Surv. Bul. **11**(1): 33–37.

1931 *f*. Insect conditions in Porto Rico during January and February, 1931. Ins. Pest Surv. Bul. **11**(2): 76–78.]

1931 *g*. Insect conditions in Porto Rico during April 1931. Ins. Pest Sur. Bul. **11**(4): 235–238, June 1.

1931 *h*. Insect conditions in Porto Rico during May, 1931. Ins. Pest Surv. Bul. **11**(5): 317–319, July 1.

1931 *i*. Insect conditions in Porto Rico during June, 1931. Ins. Pest Surv. Bul. **11**(6): 409–412, August 1.

1931 *j*. Insect conditions in Porto Rico during July, 1931. Ins. Pest Surv. Bul. **11**(7): 492–494, September 1.

1931 *k*. Insect conditions in Porto Rico during August, 1931. Ins. Pest Surv. Bul. **11**(8): 574–577, October 1.

1931 *l*. Insect conditions in Porto Rico during September, 1931. Ins. Pest Surv. Bul. **11**(9): 642–645.

1932 *a*. The initiation of an insect pest survey in Porto Rico. Jour. Dept. Agr. P. R. **16**(1): 59–64.

1932 *b*. The pink bollworm of cotton in Porto Rico. Jour. Dept. Agr. P. R. **16**(1): 65–73.

A rather detailed account of the present status of the insect.

1932 *c*. Additional references to the bean lacebug. Jour. Dept. Agr. P. R. **16**(1): 75–76.

Additions to the bibliography in the paper in this Journal by Leonard and Mills, 1931.

1932 *d*. Insect conditions in Puerto Rico during the fiscal year July 1931 thru June, 1932. Jour. Dept. Agr. P. R. **16**(2).

A number of species added to the list for the Island in various groups.

1932 *e*. Thrips injury to citrus and roses in Puerto Rico. Jour. Econ. Ent. **25**(4): 934–935.

The first identification of the blossom thrips of citrus—*Frankliniella insularis* Frank., *F. rubensis* Hood and *F. difficilis* Hood are the species involved; the one attacking roses is *F. insularis*.

1932 *f*. An early quarantine in Puerto Rico. Jour. Econ. Ent. **25**(4): 930–931.

Translation of a royal decree from Spain of August 10, 1815 against the entry of ants supposedly the bibijagua, *Atta insularis* Guer. into the Island.

1932 *g*. Notes from annual report on insect conditions in Porto Rico, July 1, 1930 thru June 30, 1931. Ins. Pest Surv. Bul. **11**(10): 682–685, February 1.

1932 *h*. Insect conditions in Porto Rico, October 1, 1931 to January 31, 1932. Ins. Pest Surv. Bul. **12**(1): 36–38, March 1.

1932 *i*. Insect conditions in Porto Rico during February and March, 1932. Ins. Pest Surv. Bul. **12**(3): 121–123, May 1.

1932 *j*. Insect conditions in Puerto Rico during April and May, 1932. Ins Pest Surv. Bul. **12**(4): 185–186, June 1.

The title is in error since records for April only are included.

1932 *k*. Insect conditions in Puerto Rico from January 1 to June 30, 1932 Ins Pest Surv Bul **12**(9) 405–408

Brief notes on the status of a number of more or less injurous species

1932 *l* The cottony cushion scale in Puerto Rico Jour Econ Ent **25**(5) 1103–1107

A brief account of the discovery, spread, foodplants and control of *Icerya purchasi* Mask in Puerto Rico Natural enemies in the Island are also discussed, most important of which is the Phorid fly, *Syneura cocciphila* Coq , the introduction of the Australian lady beetle, *Rodolia cardinalis* Muls, is especially noted

1933 *a* Notes on the giant toad, *Bufo marinus* L, in Puerto Rico Jour Econ Ent **26**(1) 67–72

General distribution life history and food habits with special reference to Puerto Rico, and successful shipments of live toads to Honolulu from Puerto Rico are discussed

1933 *b* A Braconid parasite of a Coccinellid new to Puerto Rico Jour Econ Ent **26**(1) 291

Brief note on the occurrence of *Homotylus terminalis*, Say, heavily parasitizing pupae of *Cycloneda sanguinea* L predaceous on the yellow cane aphis, *Sipha flava* Fitch

1933 *c* Notes on insect conditions in Puerto Rico for the fiscal year, July 1931 thru June 1932 In press for the April number Jour Dept Agr P R 17(2)

Leonard, M. D. and **Mills, A. S** 1931 *a* A preliminary report on the lima bean pod borer and other legume pod-borers in Porto Rico Jour Econ Ent **24**(2): 466–473.

Notes on the distribution & food plants of *Maruca testulalis* Geyer, *Etiella zinckenella* Treit *Fundella cistipennis* Dyar and *Brachyacma palpigera* Wlsm and on parasites of two of these, among 5 other borers noted *Ancylostomia stercorea* Zell was new to the Island.

1931 *b* Observations on the bean lace-bug in Porto Rico Jour Dept. Agr P R **15**(3): 309–323, 1 fig. 2 pls, July (September actual date of issue).

Distribution, economic importance, food plants, description of stages and control of *Corythucha gossypii* Fab. with an annotated bibliography of 44 titles.

Leonard, M. D. and **Seín, Jr., F.** 1931 The papaya fruit fly in Puerto Rico Jour. Econ. Ent. **24** 331–332

Results of a survey to determine the distribution of *Toxotrypana curvicauda* Gerst in the Island

1932 Observations on some factors which may affect the abundance of *Diatraea saccharalis* in Porto Rico Proc 4th Congress Int Soc Sugar Cane Techs (Preprint Bul No **92** 1–2) San Juan, P R

Léveillé, A 1907 Études sur la famille des Temnochilides Ann Soc Ent France **76** 401–402

Temnochila portoricensis described as a new species from Puerto Rico

Lewis, G. 1888 Biol Cent Am Coleoptera Histeridae **2**(7) 208

Acritus antillarum Marseul listed as occurring in Puerto Rico

Linnaeus, Carolus 1767 Systema Naturae, Ed 12 **1** 807

The original description of *Empyreuma pugione* (as *Sphinx*) from St Thomas Dr W T M Forbes believes that since this has not been recorded from St Thomas for 150 years the type specimen probably really came from Puerto Rico as the species is well known there

Loew, H 1851 Beschreibung einiger neuen Tipularia terricola Linnea **5** 396 397 and 401–402 pl 2 figs 9–12

Geranomyia rufescens (as *Aporosa*) and *Toxorhina fragilis* as new species from Puerto Rico

López Dominguez, F A. 1920 La preparacion de la disolucion arsenical para el exterminio de la garrapata Est Exp Ins P R Circ **24** 12 pp

Directions for the preparation of the arsenical dip for the eradication of the cattle tick

1927 Informe anual del director de la estación experimental insular Rio Piedras 1925–26, 62 pp

Notes on cane grubs including suggested parasite introduction and the importation of the toad, *Bufo marinus* L., from Jamaica for their control, the sugar cane root caterpillar (incorrectly called *Sufetula grumalis* Schaus), the banana root weevil and several citrus insects, including notes on *Anastrepha fraterculus* which it is stated does not infest citrus in Puerto Rico

1932 La Estación Experimental Insular, sus labores y resul-

tados alcanzados. El Agricultor Puertorriqueño **12**(5): 25–27 and 41–43, San Juan, March 15.

Brief account on p. 27 of the chief entomological accomplishments during the life of the Station.

López Tuero, Fernando. 1895. La caña de azúcar en Puerto Rico, su cultivo y enfermedad, Capítulo 4, enemigos de la caña y modo de combatirlos, pp. 63–74. Enfermedad de la caña de azúcar, pp. 105–123. Río Piedras, P. R.

Brief account of the injury and control of the more important sugar cane pests.

1896. Tratado de cultivos tropicales, pp. 1–272. 2nd ed., printed by the Boletín Mercantile in Puerto Rico.

A general treatise on various tropical crops in the discussion of several of which is included a section on diseases and insects as follows: p. 16, enemies of cotton, but no specific reference is made to Puerto Rico; pp. 87–88, coffee insects in Puerto Rico, including ants, June beetles and white grubs, the beetle known as the "encelado" or "cucarachón" and the Cossonus weevil which is undoubtedly *Lachnopus coffeae* Marshal, the changa, the "piojillo" and the "cochinilla blanca" and the "cochinilla oscura;" pp. 141–149, various sugar cane insects are discussed and control measures given for the most of them; p. 197, the grain weevil is mentioned as attacking corn, the kernels of which the larva eats out; pp. 205–206, the rhinoceros beetle is discussed as an enemy of coconuts; p. 232, white grub injury to bananas; pp. 251–272, discussion of several of the more important Antillean tobacco insects.

Luciano, José. 1922 *a*. Plagas de insectos dañinos al hogar y medios para combatirlos. Rev. Agr. P. R. **8**(1): 27–36.

Notes on cockroaches, ants, houseflies, crickets, silver fish and cloth moths and their control.

1922 *b*. Datos sobre la campaña del gusano rosado de la cápsula del algodón. Rev. Agr. P. R. **8**(3): 63–64.

Notes on the campaign against the cotton pink bollworm.

1927. La mosca mediterránea. El porqué debemos evitar la introducción de este insecto a nuestra isla. Rev. Agr. P. R. **18**(3): 143–144.

Brief general account as a basis of pointing out the necessity for the protective quarantine of the U. S. and Puerto Rico.

Ludlow, C. S. 1905. Mosquito notes—No. 4. Can. Ent. **39**: 385–388.

Aedes (*Taeniorhynchus*) *portoricensis* described as a *Culex* on page 386 from San Juan, P. R.

Lutz, A. and **da Costa Lima, A.** 1918. Contribuição para estudo das Tripaneidas (Moscas de frutas) brazileiras. Mem. Inst Oswaldo Cruz **10**(1): 4–16, 2 pls.

In a general discussion of the Brazilian fruitflies or Trypetids is it stated that the most important species, *Anastrepha fraterculus* Weid., also occurs in Puerto Rico.

Lutz, F. E. 1915. List of Greater Antillean Spiders with notes on their distribution. Ann. N. Y. Acad. Sci. **26**: 71–148.

On pages 113–115 is a general account of the Puerto Rican spider fauna with a table showing the American distribution of Puerto Rican genera. P. R. records are scattered thru the paper.

Macquart, J. 1834. Histoire naturelle des insectes dipteres, 1, pp. 229 and 450.

Hermetia albitarsus Fab. described as a new species from Puerto Rico under the name *H. sexmaculata*; also *Psilopus portoricensis* as a new species from Puerto Rico.

18[illegible]. Dipteres exotiques nouveaux ou peu connus, 3, p. 121.

Brief description of *Psilopus portoricensis* Macq. In the "Supplement" to this work (1846) the male is recorded on p. 120

Maklin, F. W. 1867. Monographie der Gattung Strongylium Kirby, Lacordaire und der damit zunachst verwandten Formen. Acta Soc. Sci. Fennicae **8**(1): 265.

S. pulvinatum described as a new species from Puerto Rico.

Malloch, J. R. 1913 *a*. A revision of the species of Agromyza Fallen and Cerodontha Rondani, (Diptera). Ann. Ent. Soc. Am **6**(3): 324, 328.

Agromyza plumiseta and *A. minima* described as new species from Puerto Rico.

1913 *b*. Descriptions of new species of American flies of the family Borboridae. Proc. U. S. Nat. Mus. **44**(1958): 361–372.

Limosina lugubrina, *L. rotundipennis* and *L. niveipennis* as new species from Puerto Rico.

1913 *c*. The genera of flies of the subfamily Botanobiinae with hind tibial spur. Proc. U. S. Nat. Mus. **46**(2024): 248–249.

Hippelates spicata as a new species from Puerto Rico.

1914. Description of a new species of Agromyza from Porto Rico. Proc. Wash. Ent. Soc. **16**(2): 89–90, fig. 1.

Agromyza inaequalis as a new species from leaves of *Vigna repens* in Puerto Rico.

M. A. M. 1932. Sobre la mosca de las frutas. Bol. Agr. (Puerto Rico) **1**(29): 3, February 27.

A brief note regarding *Anastrepha* in citrus.

Mann, Wm. M. 1920. Additions to the ant fauna of the West Indies and Central America. Bul. Am. Mus. Nat. Hist. 42, (Art. 8): 428.

Solenopsis globularia F. Smith *desecheoensis* described as a new variety from Desecheo Island, P. R.

1931. Entomology.—A new ant from Porto Rico. Jour. Wash. Acad. Sci. 21 (17): 440–441, 1 fig.

Cerapachys (Syscia) seini described as a new species from soil about roots of sugar cane.

Mari, Mariano. 1931. Cómo combatir las queresas. Rev. Agr. (P. R. Dept. Agr.) **1**(7): 3–4.

Brief directions for the control of scale insects.

Marlatt, C. L. 1903. Insecticidas importantes. Instrucciones para su preparación y uso. Dept. Interior P. R. Neg. Agr. y Minas Bol. Agr. 18, pp. 5–39. San Juan, December.

A translation of U. S. Farmers' Bul. 127, pp. 1–45, 1903 on Important Insecticides, directions for their preparation and use.

1908. New species of Diaspine scale insects. U. S. Bur. Ent. Tech. Bul. **16**(pt. 2): 26–27, pl. 7, fig. 2.

Leucaspis indica as a new species from Florida and Puerto Rico.

1920. Report of the federal horticultural board [1919–20] U. S. Dept. Agr., 29 pp.

Reference is made to a quarantine issued against cotton and cotton seed from Puerto Rico on account of the existance of *Eriophyes gossypii* Bks. there.

1928. Report [1927–28] of the federal horticultural board. U. S. Dept. Agr. 42 pp.

Euscepes batatae Waterh. is listed as having been intercepted in sweet potatoes from Puerto Rico.

Márquez, Nelson & Lizardi, Oscar. 1926. Resultados obtenidos

en la demostración número 90 sobre "represión del piche de la batata". Rev. Agr P R **17**(5) · 17, November.

Result of a demonstration in the control of the sweet potato weevil, *Cylas formicarius* Fab.

Marseul, S. A. de 1854. Essai momographique sur la famille des Histérides Ann Soc Ent France, Ser 3, **2** · 671–707

Epierus antillarum as a new species from Cuba, Puerto Rico and Santo Domingo

Marshall, Guy A. K. 1922 Some injurious neotropical weevils (Curculionidae) Bul Ent Res **13**(1) : 59–78, pl. 2, fig 4

Five species and 1 new variety described from Puerto Rico

Maskew, F. and **Strong, L. A.** 1920 Quarantine division. Reports September–December, 1920 Monthly Bul Cal Dept Agr **9**(12) · 721–725

On p 726 *Lepidosaphes beckii* is listed as intercepted from Puerto Rico on grapefruit in October and on p 734 on orange in December

1925 Root knot on sugar cane in Porto Rico Phytopathology 15( ) · 559–563, 2 figs

Symptoms and extent of injury are given and a suggestion for control

Matz, Julius. 1920 Citrus and pineapple rots Ins Exp. Sta. P R Bul **24** · 12, 3 figs

In discussing various rots it is stated that the puncturing of pineapples by mealybugs, *Pseudococcus bromeliae* (now identified as *P. brevipes*) is often responsible for the spread of disease

May, D. W. 1906 Report on agricultural investigations in Porto Rico, 1905, pp 1–21

pp 11–12 a note on control of cotton insects (*Alabama argillacea* bad during the year), p 13, a note on *Heliothis obsoleta* on corn, pp 21, a note on soaking cane seed in limewater for the control of Diatraea

1910. Sugar cane in Porto Rico P R (Mayagüez) Agr Exp Sta Bul **9** : 39 (Also a Spanish edition)

The mole cricket and white grub are mentioned as injurious

1926. Agricultural notes P. R (Mayagüez) Agr Exp Sta. Ext. Leaflet No. 26, 2 pp

Includes a note regarding the introduction of the giant toad, *Bufo marinus* L., by the P R Agr. Exp. Sta from Barbados in 1920; 60,

specimens brought in for the purpose of controlling such injurious insects as Lachnosterna spp., *Scapteriscus vicinus* and cockroaches.

1927. Germinating sugar cane. P. R. (Mayagüez) Agr. Exp. Sta. Notes No. 38, 2 pp., April 27.

Report on experiments in soaking sugar cane sets in various solutions for the control of insect pests, especially *Diatraea saccharalis* F.

1930. Report of the Director. P. R. (Mayagüez) Agr. Exp. Sta. Rept. for 1929, p. 4, 1 fig.

Brief note on the effective establishment and wide distribution of the imported toad, *Bufo marinus* L., and its benefits in reducing the numbers of certain injurious insects. The introduction of the frog, *Leptodactylus pentadactylus* from Dominica, B.W.I., for the same purpose and also possibly for food is also mentioned.

McAtee, W. L. 1932. A new neotropical genus of Eupteryginae (Homoptera) from Puerto Rico Jour. Dept. Agr. P. R. **16**(2): 119–120, 1 fig.

Hybla maculata described from mamey from Barceloneta and Pt. Cangrejos.

McClelland, T. B. 1931. The relation of the Porto Rico Agricultural Experiment Station (Mayagüez), P. R., to the agriculture of Porto Rico.—1904–1930. Agr. Notes of the P. R. Agr. Exp. Sta. No. 54, 3 pp. (Also published in the Porto Rico Progress, San Juan, P. R., shortly after.)

On p. 3 is a note regarding the introduction of the giant toad, *Bufo marinus* L., and its subsequent beneficial effect by its reduction of such insects as mole crickets, white grubs, ants and cockroaches.

McClelland, T. B. and **Tucker, C. M.** 1929. The green scale, *Coccus viridis*, a new pest in coffee and citrus. Agr. Notes of the P. R. (Mayagüez) Agr. Exp. Sta. No. 48, 2 pp. Also a Spanish edition.

Brief account of the very recent discovery of this scale in Puerto Rico, with general and local distribution and food-plants and control.

McKinley, Earl B. 1929. The salivary gland poison of *Aedes aegypti*. Proc. Soc. Exp. Biol. and Med. **26**: 806–809.

Results of attempts to immunize susceptible individuals to mosquito bites conducted in Puerto Rico.

Medina, Vicente. 1931. El control de enfermedades y plagas en los semilleros y viveros de café. Bol. Agr. (P. R. Dept. Agr.) **1**(7): 2–3.

Brief account, with control, of the coffee leaf-miner, *Leucoptera coffeella* Stainton.

Melander, A. L. 1927. Diptera. Empididae. Genera Insectorum, Fasc. 185, p. 32.

Euhybos springer as a new species from Utuado, P. R., Jan. 1899 (Aug. Busck) in U.S.N.M. Curran thinks this may be the same as his *E. spinosus*.

Menéndez Ramos, R. 1923. El pulgón amarillo de la caña. Rev. Agr. P. R. **11**(4): 23–27, 1 fig.

Brief general account of the damage and control of the yellow cane aphis, *Sipha flava* Fbs.

1924. El *"Melinitis minutiflora"* y la garrapata. Rev. Agr. P. R. **12**(4): 219–223, 2 figs.

Trials show that molasses grass does not destroy cattle ticks, *Boophilus* (*Margaropus*) *annulatus australis* Fuller, but repels them.

1926. Cómo hemos combatido el gusano agrimensor de la caña en Humacao. Rev. Agr. P. R. **16**(1): 9–11.

Merrill, Geo. B. 1915. Progress report on investigations relative to the horn-fly. Third Rept. Bd. Comm. Agr. P. R., 1913–1914, pp. 53–55.

A brief note on the introduction of predaceous beetles from Texas, Santo Domingo and Illinois.

1916. Report of the tobacco insect investigations. Fourth Rept. Bd. Comm. Agr. P. R., 1914–1915, pp. 50–52.

1923. Scale insects of Florida. Fla. State Plant Bd. Quart. Bul. 7(4): 177–298, figs. 16–116.

A number of the many species described and figured are mentioned as also occurring in Puerto Rico.

Mills, A. S. and **Leonard, M. D.** 1931. The eggs of the lima bean pod-borer in Porto Rico—Maruca testulalis Geyer (Lepid., Pyralidae). Jour. Econ. Ent. **24**(3): 763.

First note on the location and description of the eggs of this widely distributed species.

Molinary Sales, E. 1924. Demostración No. 8. **Extirpación** del gusano agrimensor (***Mocis remigia repanda***) que ataca las hojas de la caña. Rev. Agr. P. R. **13**(6): 385–387.

In the case of an infestation of sugar cane by this caterpillar dusting with arsenate of lead and lime is recommended.

Montgomery, J. H. and **Bragdon, K. E.** 1919. Quarantine Department. Qtrly. Bul. Fla. State Plant Bd. **3**(2): 110–112.

Euscepes batatae is reported as having been intercepted in sweet potatoes received from Puerto Rico into Florida during the quarter ending December 31st, 1918.

* **Moore, E. L.** 1910. Insect pests and their extermination. The P. R. Hort. News, pp. 134, 143, 144, September. (Ref. from Pedreira.)

Discusses the changa or West Indian mole cricket.

More, J. D. 1921 *a*. La vaquita o piche de la batata. Est. Exp. Ins. P. R. Circ. **34**, 7 pp. 1 pl. colored.

Brief general account of the sweet potato weevil and its control in Puerto Rico.

1921 *b*. Las pulgas del tabaco. Est. Exp. Ins. Circ. **50**, 8 pp.

Brief general account of the tobacco flea beetles in Puerto Rico and their control.

1921 *c*. Insectos predominantes durante el mes. Rev. Agr. P. R. **5**(7): 33–36.

Notes on damage by and suggestions for control of the changa and the sweet potato weevil.

1921 *d*. Instrucciones concernientes al gusano rosado del algodón. Rev. Agr. P. R. **6**(5): 21–26.

Notes concerning the life history and habits of the cotton pink bollworm in Puerto Rico, for the information of cotton growers.

1923. Insects, fish and other fauna of Porto Rico. The Book of Porto Rico, pp. 54–64, several figs. San Juan.

A very brief account of the more important injurious insects of the Island in both Spanish and English.

Morgan, A. C. 1925. A new genus, a new subgenus and seven new species of Thysanoptera from Puerto Rico. Florida Entomologist **9**(1): 1–9.

Ceroyothrips striatus n. gen. and sp.; *Sericothrips portoricensis* and *Anaphothrips bicolor* n. spp.; *Lissothrips* (*Prolissothrips*) *stratulus* n. subgen and sp.; *Gastrothrips fuscicauda*, G. *anolis* and *Diceratothrips wolcotti* n. spp.

Morrison, Harold. 1932. On some trophobiotic Coccidae from British Guiana. Psyche **29**(4): 145–148. pl. 6, figs. 20–31.

Akermes secretus new species from Puerto Rico [=*Cryptostigma* (*Pseudophillipia*) *inquilina* (Newstead) Ferris].

Moschler, H. B. 1890. Die Lepidopteren-Fauna der Insel Portorico. Abhandlungen Senkenbergischen Naturforschenden Gesellschaft **16**, Heft 1, pp. 69–360, 1 pl

Catalog of the Lepidoptera of the Island based on the same material as Gundlach's paper; many new species are described.

Moser, J. 1918 Neue Arten der Gattungen *Lachnosterna* Hope und *Phytalus* Er (Col) Stett Ent Zeitg **79** · 19–74

Phyllophaga (*Lachnosterna*) *insulicola*, p 61 and *P portoricensis* (Chevrolat in lit), p 62 described as new species from Puerto Rico.

Muesebeck, C. F W. 1921. A revision of the North American species of ichneumon-flies belonging to the genus Apanteles Proc U S Nat Mus **58** (2349) 558–559

Apanteles prenidis new species from Puerto Rico reared from *Prenes ares* Felder

Muir, F. 1918 Homoptera notes II Proc Hawaiian Ent. Soc. **3**(5) 414–429

Cyclokara sordidulum as a new species p 416, and *Otiocerus schonherri* Stal p 420, recorded from Puerto Rico (Derbidae), *Ugyops occidentalis* and *Punana puertoricensis*, p 425 as new species and *Nomalacra flava* as a new genus and species, p 426 (*Delphacidae*) from Puerto Rico

* 1922 Direct and indirect injury to plants by insects Hawaiian Planters' record **2** 65 66 (Abs in Rev Appl Ent **10** · 347)

Sugar cane mosaic not so serious in Hawaii as in Puerto Rico due possibly to the presence in the latter place of insect vectors which carry the disease directly from unhealthy to healthy cane whereas in Hawaii it is carried by occasional visitors to the plants

1924 New and little known Fulgorids from the West Indes (Homoptera) Proc Hawaiian Ent Soc for 1923 **5**(3): 461–472, pl XII

Ormenis pseudomarginata (Flattidae), p 469–470, *Acanalonia brevifrons* (Acanaloniidae), p 467, *Cubana tortriciformis* (Cixiidae), p. 461, *Cedusa wolcotti* (Derbidae), p 462, *Dysimia* (new genus) *maculata* (Derbidae), pp 462–464, *Parahydriena* (new genus) *hyalina* (Derbidae), pp 464–465, *Colpoptera brunneus* (Issidae), pp 465–466 and *C. maculifrons* (Issidae), p 466, all as new species from Puerto Rico.

Muir, F. and **Gifford, W. M.** 1924 Studies in North American

Delphacidae. Hawaiian Sugar Planters' Exp. Sta. Bul. 15 (Ent. Ser., pp. 9, 17).

> *Neomalaxa flava* Muir recorded as occurring in Puerto Rico and *Nilaparvata wolcotti* described by Muir as new species from Puerto Rico.

Mutchler, A. J. 1923 *a*. Notes on West Indian Lycidae and Lampyridae (Coleoptera) with descriptions of new forms. Am. Mus. Novitates No. 60, 13 pp., 1 fig. March 15.

> *Callopisma borencona* as a new species from several localities (Lycidae) on p. 9 and *Pyractomena galeata* E. Oliver listed from Puerto Rico.

1932 *b*. Notes on West Indian Lampyridae and Cantharidae (Coleoptera) with descriptions of new forms. Am. Mus Novitates No. 63, 9 pp., 1 fig., March 29

> *Photinus heterodoxus* L. & M., *P. dubiosus* L. & M., *P. vittatus* G. A. Oliv., and *Tytthonyx discolor* L. & M listed from Puerto Rico with notes.

Myers, J. G. 1931 *a*. A preliminary report on an investigation into the biological control of West Indian insect pests. Empire Marketing Board 42: 53–54, 78, London.

> Brief mention of the status of several of the more important insect pests of Puerto Rico.

1931 *b*. Descriptions and records of parasitic Hymenoptera from British Guiana and the West Indies. Bul. Ent. Res. **22**: 267–277, 3 figs.

> *Microdus stigmaterus* Cress., p. 274, mentioned as having been artificially introduced into Puerto Rico by Box.

Nesbit, D. M. 1903. La batata. Dept. Int. P. R. Neg. Agr. y Minas Bol. Agr. 16, pp. 33–34.

> Brief general account of the most important classes of insects injurious to the potato in this Spanish translation of U. S. Farmers' Bul. 129.

Nolla, J. A. B. 1924. Resultados de la demonstración No. 20 sobre el control de la changa en un semillero de cebollas. Rev. Agr. P. R. **12**(3): 202.

1929 *a*. Acrostalagmus aphidum Oud. and aphid control. Jour. Dept. Agr. P. R. **13**(2): 59–72.

> Excellent results by spraying liquid cultures of this fungus in the

control of 7 determined species of commom aphids and 2 undeternined species in Puerto Rico.

1929 *b*. Un hongo parasitario de los áphidos. Rev. Agr. P. R. **23**(5): 196–197.

Brief popular version of the above paper.

1929 *c*. El Acrostalagmus aphidum Oud. en la lucha contra los áfidos. Mem. Soc. Esp. Hist. Nat. **15**: 9–12, 1 fig., 1 pl.

Much the same information as in 1929 a.

Notman, Howard. 1929. New species of *Palaminus* from the West Indies, together with a synoptic review of the genus Am. Mus. Novitates No. 386, 17 pp., November 27.

P. lengi, parvipennis, bifida, scitulus, pusillus, grandicollis, procerus as new species and *P insularis* Cameron listed from Puerto Rico.

Ochs, Geo. 1924. On the West Indian Gyrinidae and a new species of Gyretes from Northern Brazil Am. Mus. Novitates No. 125, 8 pp., July 24.

Dinutus carolinus LeConte, *D. mutchleri* as new species and *D. longimanus* (Oliv) *portoricensis* as new subspecies from Puerto Rico; *Gyrinus rugifer* Regimbart and *Dinutus metallicus* Aubé listed from Puerto Rico with notes.

[**Olivier, A. G.** 1790. Entomologie **2** No. 28. p. 23. pl. 3. fig. 20.

Photinus vittatus is described as a new species from Santo Domingo only. Wolcott in his "List" on p. 82 states that the types were from Puerto Rico also. The species is, however, widely distributed in Puerto Rico].

1807. Entomologie **5**, No. 83, p. 145.

Baris torquatus (as *Rhynchaenus*) and *R. militaris* (probably now in *Pseudonus*) as new species from Puerto Rico.

1808. Entomologie **6**, No. 93, pp. 635–636.

Galerucella obliterata as a new species from Puerto Rico.

Olivier, E. 1899. Revision des coléopteres Lampyrides des Antilles et description des espéces nouvelles. Bul. Soc. Ent. France **24**: 87–92.

Lecontea galeata (as *Pyractomena*) as a new species from Puerto Rico on p. 91.

1912. Contribution a la faune entomologique des Antilles.

Lampyrides. Rev. Sci. du Bourbonais et du centre de la France, **25**: 19 and 33.

Callopisma dimidiatipennis Oliv. p. 19 and *Photinus triangularis* Oliv. p. 33 listed from Puerto Rico.

1912 *b*. Lampyrides faisant partie des collections du musée de Washington. Ann. Soc. Ent. Belgique **56**: 25.

Photinus triangularis as a new species from Puerto Rico

Osborn, Herbert. 1928 Neotropical Homoptera of the Carnegie Museum. Part 6. Report on the subfamily Typhlocybinae with descriptions of new species. Ann. Carnegie Mus. **18**(2): 253–298.

Protalebra bicincta, p. 259 and *P. pallida*, p. 260 as new species and *P. similis* Baker pp 263–264 listed from Puerto Rico

1929 Notes on Porto Rican Homoptera Jour Dept Agr P R. **13**(3): 81–82.

Records a number of species mostly based upon a collecting trip to the Island during the winter of 1928–1929; 7 species of leafhoppers are described as new, general discussion of ecology and distribution

Osten Sacken, C. R. 1887 Studies on Tipulidae, Part 2 Berl. Ent. Zeitschr. **31**: 184

Rhamphidia albitarsis as a new species from Puerto Rico

Osuna, Pedro. 1929. Medios para combatir los insectos en las hortalizas Rev. Agr P R **23**(2): 82 and 95.

Brief practical directions for the control of vegetable insects

Pagenstecher, Arnold. 1907 Die Lepidopteren Fauna der Antillen Jarb. Nassauische Ver Naturbunde **60**: 91–92 Weisbaden.

On p. 97 is a brief geographical summary of Puerto Rican Lepidoptera with references to several of the more important papers on the subject

Parker, R. R. 1914. Sarcophagidae of New England: males of the genera Ravinia and Boettcheria.

Sarcophaga quadrisetosa Coq. (as *Ravinia*) listed as occurring in Puerto Rico.

Pastor Rodríguez, Juan. 1929. El cultivo del algodón Sea Island. Rev. Agr. P. R. **22**(10): 157–158 and 172.

Notes on the injury and control of the more important insects of Sea Island cotton in Puerto Rico are included.

1931 *a*. Alarmante irrupción de la oruga rosada del algodón en el distrito sur Rev Agr P R. **26**(9):174, 176

Brief account of the outbreak of the pink bollworm of cotton during the previous season in the South coast of the Island.

1931 *b* Alrededor de la oruga rosada (*P gossypiella*) Bol Agr (P R Dept Agr) **1**(6) 2-3

Brief account of the increased infestation of the pink bollworm in the south coast during the past season with a sketch of the life history and outline of control measures

1932 Porto Rico moves forward in cotton Cotton Trade Journal International Edition 1932 pp 91-93 1 map 3 figs, 2 tables New Orleans La

On p 93 is a brief discussion of the status of the more important insect pests in Puerto Rico—the pink bollworm and the cotton leaf worm the absence of the boll weevil is noted

Altho this article bears no authorship it was written by Mr Pastor Rodriguez

Pedreira, Antonio S 1932 Bibliografía Puertorriqueña (1493 1930) Monografías de la Universidad de Puerto Rico Serie A Estudios Hispanicos Num 1 Madrid XXXII 707 pp

Contains about 200 references to articles on Puerto Rican entomology about 17 of which are under the heading of 'Entomologia economica' and the remainder scattered thru several other sections

Pemberton, C E and **Leonard, M D** 1932 Entomology at the Fourth Congress of the International Society of Sugar Cane Technologists in Porto Rico Jour Econ Ent **25**(3) 732 733 Also under same title in Ent News **43**(7) 195-196

Brief note giving names of entomologists in attendance and general subjects of papers presented at the Congress

Pérez Torres, Manuel. 1922 Fiebre tejana Rev Agr. P R **22**(5) 220-221 225 1 fig

A general discussion of Texas fever with brief directions for its control by ridding the cattle of ticks

Pergande, T. and **Cockerell, T. D. A** 1900 List of the Coccidae collected by Mr A Busck in Porto Rico, 1899 U S Dept. Agr Div Ent Bul **22**, New Series pp 92-93

Twenty three listed with dates of collection and food plants

Petrunkevitch, Alex 1911 A synoptic index-catalogue of spiders of North Central and South America with all adjacent

islands, Greenland, Bermuda, West Indies, Tierra del Fuego, Galápagos, etc. Bul. Am. Mus. Nat. Hist. **29**: 1809.

All spiders recorded to date from Puerto Rico are listed.

1926. Tarantula versus tarantula-hawk: a study in instinct. Jour. Exp. Zool. **45**(2): 367–393, 2 pls.

A contribution from the University of Puerto Rico in which the attack of the tarantula-hawk, *Pepsis marginata* P. de B. upon *Cyrtophilus portoricae* Chamb, under observation cage conditions at Río Piedras, P. R., is described in detail.

1929. The spiders of Porto Rico Part One. Trans. Conn. Acad. Arts and Sci. **30**: 1–158, 150 figs.

1930 *a*. The spiders of Porto Rico. Part Two. Trans. Conn. Acad. Arts and Sci. **30**: 159–355, 240 figs.

1930 *b*. The spiders of Porto Rico. Part Three. Trans. Conn. Acad. Arts and Sci. **31**: 1–191, 168 figs.

One hundred seventy-four species are described in detail in the above 3 parts, 72 of which are described as new.

Phillips, E. F. 1914. Porto Rican beekeeping. P. R. (Mayagüez) Agr. Exp. Sta. Bul. **15**, 24 pp., 2 pls. Also a Spanish edition, 28 pp., 1915.

Pierce, W. Dwight. 1914. Descriptions of two new species of Strepsiptera parasitic on sugar cane insects Proc. Ent. Wash. **16**(3): 126–129.

Stenocranophilus quadratus as a new genus and species reared from *Saccharosydne saccharivora* Westw. in Puerto Rico.

1915. Some sugar-cane root-boring weevils of the West Indes. Jour. Agr. Res. **4**(3): 255–264, 4 pls.

Description of and notes on *Diaprepes famelicus* (not in P. R.) Oliver and *D. spengleri* & its varieties, of which *D. s. spengleri*, *comma* and *abbreviatus* are stated to occur in Puerto Rico.

1917. A Manual of dangerous insects likely to be introduced into the United States through importations. U. S. Dept. Agr. Office of Sec'y. Contrib. from Bur. Ent. and Fed. Hort. Bd., Aug. 15.

An occasional specific reference to Puerto Rico.

1918. Weevils which affect Irish potato, sweet potato and yam. Jour. Agr. Res. **12**(9): 608, pl. 32, figs. C, D.

Records having specimens of *Euscepes batatae* from Mayaguez, P. R. which were injuring sweet potatoes.

Quaintance, A. L. 1900. Contributions toward a monograph of the American Aleurodidae. U. S. Bur. Ent. Tech. Bul. **8**: 43–47, pl. 6, figs., 63–67.

Aleurodicus (Metaleurodicus) minimus as a new species from Puerto Rico.

Quaintance, A. L. and **Baker, A. C.** 1915. Classification of the Aleyrodidae. Parts 1 and 2. U. S. Bur. Ent. Tech. Bul. **27**: 1–114 pp., many pls. & figs.

I fail to find *Dialeurodes buscki* as a new species from Puerto Rico, but ***Aleurodicus minimus*** **Quain. is redescribed in the new subgenus** ***Metaleurodicus*** **on p. 77 and** ***Leonardius lahillei*** **Leonardi is redescribed** on p. 33, both from Puerto Rico.

Quedenfeldt, G. 1886. Neue und seltnere Käfer von Portorico. Berl. Ent. Zeits. **30**(1): 119–128.

Ten new species and 1 new variety, including 1 new genus, described from Puerto Rico.

Quintañilla, Guillermo. 1896. Enfermedad de los cafetales en Adjuntas, la plaga de la vaquita. La Reforma Agrícola (Organo de la Asociación de Agricultores de Puerto Rico) year 3, No. 12: pp. 217–224. November.

Records an inspection trip to Adjuntas in April 1895 to investigate an outbreak of a weevil on coffee, which according to local growers had been doing more or less damage for the last [illegible] years. It is stated that the adult injures the leaves, green shoots, buds, flowers and fruit of the coffee trees; a sketchy description of some length is given of the adult and the author judges that it belongs to the genus Cossonus (he spells it Cossmus) of the Curculionidae. Larvae and pupae were not found. It is suggested that the soil be put in better condition for coffee production and after sufficient experimentation that control measures should be used directly against the adult weevils. It is reported that growers had tried spraying with petroleum, fenic acid, and with hypochlorite of lime with very contradictory results.

Altho Quintanilla's description of the adult weevil is very general, neither length nor color even being mentioned, there seems little doubt that the insect under discussion is *Lachnopus coffeae* Marshall, or possibly of course var. *montanus* **Marshall**, both of which were not described until 1922. If so Quintanilla's is the earliest published account of the insect.

Rehn, James A. G. 1903*a*. Notes on West Indian Orthoptera,

with a list of the species known from the Island of Porto Rico. Trans. Am. Ent. Soc. **29**: 129–136.

Many species listed, including *Apterygida buscki* (Blattidae), p. 129 and *Lamponius portoricensis* (Phasdimae), p. 132 as new species from Puerto Rico *Neoblatella adspersicollis* Stal.

1903 *b*. Studies in American Blattidae. Trans. Am. Ent. Soc. **29**: 268–285

Blatella azteca S. & Z., p. 268, *Periplaneta americana* L., p. 280 and *Panchlora hyalina* Sauss., p. 285 listed from the Island and *Pelmatosilpha coriacea*, pp. 278–279 as a new species from Puerto Rico.

1904. Studies in the orthopterous family Phasmidae. Proc. Acad. Nat Sci. Phila. **56**: 68-69.

Aplopus achalus (Phasmidae) described from Puerto Rico as a new species.

1906 The orthoptera of the Bahamas. Bul. Am. Mus. Nat. Hist. **22** (Art. 5): 110, May 23

A foot note states "This is the species recorded by me as *B. punctulata* from Puerto Rico (Trans. Amer Ent. Soc. xxix p. 130) and *B. azteca* from Puerto Rico and Jamaica (Ibid., xxix, p. 268)." The species referred to is *Neoblatella adspersicollis* Stal.

1910. On some Orthoptera from Porto Rico, Culebra and Vieques Islands. Bul. Am. Mus. Nat. Hist. **28** (Art. 7): 73–77.

Epilampra wheeleri (Blattidae) as a new species from Puerto Rico, pp. 73–74.

Rehn, J. A. G. and **Hebard, Morgan.** 1927. The Orthoptera of the West Indies. Number 1 Blattidae. Bul. Am. Mus. Nat. Hist. **54** (Art. 1): 1320, 25 pls

Thirty species from Puerto Rico treated.

Reitter, Edm. 1875 Die Sud—und Mittel—Americanischen Arten der Gattung Tenebroides Pill et Mitterp Verh. Nat. Ver. Brünn (for 1874) **13**: 74.

Tenebroides punctulatus listed from Puerto Rico.

1878. Neue Colydiidae des Berliner Museums. Deutsche Ent. Zeitschr. **22** (1): 123.

Penthelispa aquicolle as a new species from Puerto Rico.

1883. Beitrag zur Kentniss der Clavigeriden, Pselaphiden und

Scydmaeniden von Westindien. Deutsche Ent. Zeitschr. **27** (1) : 33–46.

Trimiopsis ventricosa on p. 39, *parmata* on p. 40 and *eggersi* on p. 38 as new species from St. Thomas and Puerto Rico.

Richardson Kuntz, Pedro. 1932. Censo de las variedades de caña de azúcar sembradas en Puerto Rico correspondiente a la cosecha de 1931–32. Est. Exp. Ins. Circ. **98**: 14–16.

It is stated that, in the author's opinion, *Diatraea saccharalis* Fab. causes at the present time five times as much damage in the South and East Coast districts as the three most important cane diseases combined, namely mosaic, gummosis and Pokka Boeng. *Phyllophaga* spp and *Scapteriscus vicinus* are also mentioned as being injurious to cane but of secondary importance to the moth borer.

Riley, C. V. 1894. The insects occurring in the foreign exhibits of the world's Columbian Exposition. Insect Life **6**(3) : 218.

Cathartus advena Waltl. listed as occurring in Puerto Rico.

Riollano, Arturo. 1931. Rehabilitación agrícola de Vieques. Informe del trabajo realizado. Rev. Agr. P. R **26**(9) : 108–116, March

Includes notes on several injurious insects including the cotton leafworm, pink bollworm and the cowpea stalk and pod borer, *Fundella cistipennis*

Ritchie, A. H. * 1917. Report of the government entomologist for the year 1916–1917. Suppl to the Jamaica Gazette, Kingston, **40**(4) : 92–97. (Abs in Rev. Appl. Ent. **5**: 429.)

In discussing *Stenocranus saccharivorus* Westw. as a cane pest mention is made that parasites are an effective check in Puerto Rico, including a Mymarid, a Dryinid and a Strepsipteron.

* 1918. Annual report of entomologist. Ann. Rept. Jamaica Dept. Agr. for year ended 31st March, 1918, pp. 34–40. (Abs. in Rev. Appl. Ent. **7**: 56.)

In discussing *Euscepes porcellus* Boh. mention is made that it also occurs in Puerto Rico.

Rivera, Alfonso. 1922. Enfermedades de la piel en el ganado. Ins. Exp. Sta. P. R. Circ. **58**: 1–9.

Notes on the various skin parasites found on cattle, pigs, sheep and goats, with symptoms and remedies; the tick, *Ixodes ricinus* and mange mites are included.

Rivera, Eugenio M. 1927. Informe sobre el trabajo de es-

1897. Orthoptera. Biol. Centr. Am. **1**: 276–277.

Orocharis vaginalis and *O. terebrans* (Gryllidae) as new species from Puerto Rico.

Schaufuss, L. W. 1882. Coléopteres aveugles de la famille des Colydidae. Ann. Soc. Ent. France, (Ser. 6) **2**: 46–48.

Cryptosoon nitidicollis as a new genus and species from Puerto Rico.

Seely, R. M. 1928. Revision of the spider genus Tetragnatha. N. Y. State Mus. Bul. **278**, pp. 106 and 133, pl. 1, figs. 1–4 and pl. 3, figs. 40–43.

T. antilliana Simon, p. 106 recorded on the authority of Banks (1901) and *T. pallescens* Cambridge p. 133 recorded from Puerto Rico at Toa Baja, Garb collector.

Seín Jr., Francisco. 1923 *a*. Cucarachas. Est. Exp. Ins. Circ. **64**: 1–12.

A discussion of the injurious cockroaches in Puerto Rico and their control.

1923 *b*. Las abejas en los cafetales. Est. Exp. Ins. Circ. 79: 1–6.

Observations to show that beekeeping is not injurious to the setting of berries in the coffee farms, but rather that the bees are beneficial.

1923 *c*. El gorgojo del ñame del guineo. Est Exp. Ins Circ. **82**: 1–7, 2 figs.

Brief general account of the banana rootweevil in Puerto Rico with control measures.

1926. La oruga de la raíz de la caña. Un insecto que no se sabía existiera en Puerto Rico y que causa mucho daño. Rev. Agr. P. R. **17**(2–3): 17.

Notes on the sugar cane root-caterpillar, *Perforadix sacchari* Sein in Puerto Rico.

1927. El sapo. Rev. Agr. P. R. **19**(5): 238–240.

Notes on the imported toad, *Bufo marinus* L., in Puerto Rico.

1928. Sericultura Rev. Agr. P. R. **20**(2): 51–53.

Brief general popular account of the silk industry and remarks on its attempted initiation in Puerto Rico.

1929 *a*. Report of the division of entomology. Ann. Rept. Ins. Exp. Sta. P. R. for 1927–1928, pp. 89–98.

Altho no authorship is assigned in this report it was prepared by Mr Seín It includes notes on sugar cane root insects and mosaic transmission, *Anastrepha* does not attack citrus, banana root weevil and on failure of *Ipobracon grenadensis* to become established.

1929 *b* El gorgojo del ñame del guineo en Puerto Rico El Mundo, San Juan, P R, October, 6, p 15, 4 figs

A general account of the banana root weevil in Puerto Rico including control measures outlined in detail

1929 *c* Nuevas cosechas nuevas plagas Rev Agr P R **23** (2) 84–86

A note on the potato tuber moth (*Phthorimaea operculella* Zell.) attacking Irish potatoes for the first time in Puerto Rico

1929 *d* Una invasion de mariposas Rev Agr P R **22**(10) 169 170

Notes on a large migration of *Anosia plexippus* L in Puerto Rico

1930 *a* A new mechanical method for artificially transmitting sugar-cane mosaic Jour Dept Agr P R **14**(2) 49–68

1930 *b* The sugar cane root caterpillar and other new root pests in Puerto Rico Jour Dept Agr P R **14**(3) 167–191 10 pls

Complete account of *Perforadix sacchari* Seín (Pyralididae, Endotrichinae) new genus and species in Puerto Rico, including descriptions of all the stages and suggestions for lessening the injury A Symphilid, *Hanseniella* sp, two bristle tails, *Nicoletia* sp and *Lepisma* sp, a sow bug, *Philoscia culebrae* Moore, white grubs, nematodes, the larvae of *Diaprepes spengleri* and a mite are all discussed as to their relation to root injuries to sugar cane in Puerto Rico

1930 *c* Nuevo metodo de transmitir el matizado y su aplicacion práctica Rev Agr P R **25**(2) 64–65 94

A brief account of a new method of transmitting artifically sugar cane mosaic and its practical application This method is described in detail in Seín 1930 *a*, which see

1930 *d* Insectos que atacan la alfalfa en Puerto Rico Rev Agr P R **25**(2) 91

A brief account of *Dichomeris piperata* Wlsm as a new pest of alfalfa.

1930 *e* *Dichomeris piperatus* Walsingham a pest of alfalfa in Puerto Rico Jour Econ Ent **23**(5) · 885–886

A brief note on this species as a new pest of a new crop

1931 *a*. The pickle worm in chayote in Porto Rico. Jour. Econ. Ent. **24**(3): 762.

1931 *b*. Informe sobre el brote del "Apate francisca" en Lares. El Agricultor Puertorriqueño **11**(7): 24, San Juan.

Records a destructive outbreak of the coffee stem borer in coffee and several other economic food plants.

1931 *c*. El peligro de que pueda introducirse una nueva plaga del café. Bol. Agric. **1**(17): 2, December 5, San Juan.

A short note on the danger of introducing the coffee weevil, *Stephanoderes coffea*, into Puerto Rico.

1932 *a*. Artificial transmission and other studies on sugar cane mosaic. Proc. Fourth Congress Int. Soc. Sugar Cane Techs., pp. (Preprint Bul. **84**): 1–6. San Juan.

Includes notes on *Aphis maidis* and *Sipha flava*.

1932 *b*. Soil animals and root disease in Porto Rico. Proc. Fourth Congress Int. Soc. Sugar Cane Techs. pp. (Preprint Bul. **91**): 1–2. San Juan.

Sepulveda, A. E. 1931. La oruga roedora de la hoja del algodon. Campaña para combatirla. Rev. Agr. P. R. **26**(9): 88, March.

Notes on a control campaign against a bad outbreak of the cotton leaf worm.

Sharp, David. 1890. Biologia Cent. Am. Coleoptera Nitidulidae **1**(2): 304.

***Coproporus* (as *Trichomus*) *rutilus* as a new species from St. Thomas and Puerto Rico and *Colopterus* (as *Colastus*) *truncatus* Rand. listed from Puerto Rico.**

Sicard, A. 1922. Descriptions de variétés espèces et genres nouveaux appartenant a la famille de Coccinellides. Ann. and Mag. Nat. Hist. (Ser. 9) **9**: 349–360.

***Scymnillus variipennis*, *S. nunenmacheri*, *Scymnillodes cyanescens*, and *Psorolymna maxillosa*, all as new species from Puerto Rico.**

Smyth, E. G. 1916. Report of the South Coast laboratory. Fourth Rept. Bd. Comm. Agr. P. R. from July 1st to June 30th 1915, pp. 44–50.

Note on fumigation with sulfur of boats with cane coming to Puerto Rico from Santo Domingo to prevent introduction of *Caliseto pulchellus* (as *archebates*); white grub life history studies.

1917 *a*. Report of the entomological department. Ann Rept. Ins. Exp. Sta. P. R. from 1st July, 1916 to 30th June, 1917, pp. 96–106.

A summary of incoming plant inspection interceptions; reference is made to the fumigation of sugar cane entering from Santo Domingo to prevent introduction of the cane butterfly, *Calisto pulchellus* (*C. archebates* is used).

1917 *b* The white grubs injuring sugar cane in Porto Rico. I Life-cycles of the may beetles or melolonthids. Jour Dept. Agr. P. R. **1**(2) : 47–92, 8 pls. and **1**(3) : 141–169.

P. portoricensis, vandinei, citri, guanicana, described as new species.

1918. Cómo combatir el gorgojo de la batata. Rev. Agr. P. R. **1**(3) : 136–139

Control of the sweet potato weevil.

1919 *a* A résumé of plant quarantine work in Porto Rico from July 1910 to July 1919 Ins. Exp. Sta P. R. Bul. **23**, 56 pp., 20 tables.

The title of the bulletin itself is "Plant inspection and quarantine report (1918–19)."

1919 *b* Insects and mottling disease Jour Dept Agr. P. R. **3**(4) : 83–116.

Inoculation experiments with several species of insects

1919 *c*. An annotated bibliography of Porto Rican cane insects. Jour. Dept Agr. P. R **3**(4) : 117–134.

1919 *d*. List of the insects and mite pests of sugar cane in Porto Rico Jour Dept Agr P R **3**(4) : 135–150.

1919 *e*. Un insecto extraño que cubre su cría lo mismo que una gallina. Rev. Agr. P. R. **2**(4) : 27–31, 2 figs.

Notes on the habits of *Pachycoris torridus* Scop.

1919 *f*. Dominio de insectos de los cítricos en Puerto Rico. Rev. Agr. P. R. **3**(1) : 39–50 and **3**(3) : 55–62.

Directions for the control of the more important citrus insects.

1919 *g*. Cómo se coleccionan y conservan los insectos. Rev. Agr. P. R. **3**(2) : 17–33.

Directions for collecting and preserving insects.

1919 *h*. Dominio de la plaga de la mosca del ganado en Puerto Rico. Rev. Agr. P. R. **3**(5): 10–**24**(6): 17–28, 4 pls.

Suggestions on the control of the horn fly of cattle, *Haematobia irritans* L.

1919 *i*. Dominio de la plaga de la mosca cornúpeta del ganado en Puerto Rico. Rev. Agr. P. R. **3**(6): 17–28.

Almost the same as above.

1919 *j*. Report of the Division of entomology. Ann. Rept. Ins. Exp. Sta. P. R. 1st July, 1917 to 30th June, 1918 pp. 109–129.

Notes on insect pest interceptions in connection with quarantine work; experiments in dissemination of sugar cane mosaic by insects; cane insects; rhinoceros beetle injury to coconuts; vegetable insects and on termites.

1919 *k*. Report of the division of entomology. Ann. Rept. Ins. Exp. Sta. P. R., 1918–1919, pp. 27–31.

Notes on further experiments in the transmission of sugar cane mosaic by insects and on experiments with paraffin oil emulsion for the control of scale insects; this latter was ineffective against *Pseudococcus nipae* on guava.

1920 *a*. The white grubs injuring sugar cane in Porto Rico. II. The rhinoceros beetles. Jour. Dept. Agr. **4**(2): 3–29, 4 pls.

A detailed study of the economic importance, life history and control of *Strategus titanus* and *S. quadrifoveatus*.

1920 *b*. Nuestro amigo el Anolis. Rev. Agr. P. R. **4**(5): 11–21.

Notes on the various insects eaten by the abundant and wide-spread lizards of the genus Anolis in Puerto Rico.

1920 *c*. Informe de la división de entomología. Mes de junio. II. La junta técnica de cuarentena. Rev. Agr. P. R. **5**(4): 29–34.

Notes on cotton insects and the visit of U. C. Loftin to look for the cotton pink bollworm.

1920 *d*. Cotton insects in Porto Rico. Ent. News **31**(5): 121–125.

A summary account of all the insects observed to date affecting cotton in the Island with notes on their distribution, injury and control.

1920 *e*. To keep out cane butterfly. Jour. Econ. Ent. **13**(1): 149.

Note on successful efforts of the plant quarantine officials in Puerto Rico to keep cane from being shipped into the Island from Santo Domingo in order to prevent the introduction of the cane butterfly, *Calisto pulchellus* (given as *C. archebates*).

1920 *f*. Annual report, division of entomology Ann. Rept. Ins. Exp. Sta. 1919–20, pp. 83–89.

Notes on continuation of work with insects as transmitters of cane mosaic, inauguration of a special plant quarantine service and recent regulations against cotton from Puerto Rico on account of *Eriophyes gossypii*.

1921. La mosca del ganado. Est. Exp. Ins. Circ. **39**: 1–17, 4 pls.

General account of the horn fly of cattle in Puerto Rico with remedies. A revision of Smyth 1919 *h*.

Snyder, P. G. 1920. Beekeeping in foreign lands. Gleanings in Beeculture **48**: 721–724, 3 figs.

Refers entirely to conditions in Puerto Rico.

Snyder, T. E. 1923. A new Glyptotermes from Porto Rico. Proc. Ent. Soc. Wash. **25**(4): 91–93, pl 8.

***Glyptotermes corniceps* from Boquerón, P. R.**

1924. Descriptions of new species and hitherto unknown casts of termites from America and Hawaii. Proc. U. S. Nat. Mus. Vol. **64**, (No. 2496, Art. 6): 10–12, pl 2

***Glyptotermes pubescens* as new from Puerto Rico.**

Stahl, Agustín. 1882. Fauna de Puerto Rico. Clasificación sistemática de los animales que corresponden a esta fauna y catálogo del gabinete zoológico del Doctor A. Stahl en Bayamón, P. R. Imprenta del Boletín Mercantil, San Juan, P. R. Insects, Pt. 2, pp. 169–213

A list of the species of insects in Dr. Stahl's collection in Bayamón, P. R., from Cuba, Trinidad and Puerto Rico.

* 1894. La enfermedad de la caña y el caculo. Imp. Sucesión J. J. Acosta, 18 pp., San Juan P. R. (Reference from Pedreira.)

Stevenson, J. A. 1918 *a*. Cuarentena de las plantas. Rev. Agr. P. R. **1**(4): 176–180.

A brief article on the reasons for and operations of plant quarantines.

1918 *b*. The green muscardine fungus in Porto Rico. (*Metarizhium anisopliae* (Metsch.) Sorokin.) Jour. Dept. Agr. P. R. **2**(1): 19–32, 3 figs.

The species of insects attacked by the fungus in breeding cages in Puerto Rico is given and includes *Phyllophaga* and other common Scarabeids. Conclusion is reached that it will not serve as a practical means of controlling white grubs in the Island due to great dependance on humidity and other factors.

Stevenson, J. A. and **Cotton, R. T.** 1918. Preparation and use of lime-sulfur Ins. Exp. Sta. Circ. **13**, 9 pp.

Strong, L. A. 1921 *a*. Quarantine Division. Reports for the months of July and August 1921. Mthly. Bul. Cal. Dept. Agr. **10**(9): 381–385.

Records *Lepidosaphes beckii* intercepted on grapefruit from Puerto Rico.

1921 *b*. Quarantine division. Synopsis of work for the month of March, 1921. Mthly. Bul Cal. Dept. Agr. **10**(5–6): 212

Lepidosaphes beckii listed as intercepted on grapefruit from Puerto Rico.

1922. Bureau of plant quarantine. Synopsis of work for the months of January and February 1922. Mthly. Bul. Cal. Dept. Agr. **9**(5–6): 471–476.

Records *Lepidosaphes* beckii intercepted on oranges from Puerto Rico.

Suffrian, C. G. L. E. 1852. Zur Kentniss der Nordamerikanischen Cryptocephalen Linnaea Entomologica **6**: 282 283 and **7**: 85 and 203.

Vol. **6**: 282–283, *Cryptocephalus nigrocinctus* as a new species and Vol. **7**: 85 and 203, *Cryptocephalus polygrammus* and *Pachybrachys praetextatus* as new species, all from Puerto Rico.

Tapia y Rivera, Alejandro. 1854. Biblioteca histórica de Puerto-Rico, que contiene varios documentos de los siglos XV, XVI, XVII y XVIII, coordinados y anotados. 6 + 587 pp. + 14, Puerto Rico.

On pp. 21–22 is a brief note that in 1510 Sotomayor founded the settlement of Guánica which he and his companions were obliged to vacate because of the great abundance of mosquitoes. (Oviedo, q. v.).

Teague, M. M. 1925. A review of the genus Aclerda (Hemiptera; Coccoidea). Ann. Ent. Soc. Am. **18**(4): 439, 3 figs.

Acleida sacchari described as a new species from Arecibo and Morovis, P. R., on stalks and roots of sugar cane (Geo. N Wolcott, collector)

Thomas, W. A 1928 The Porto Rican mole cricket U. S Farmers' Bul 1561 pp 1–9 3 figs

General account of economic importance life history and control of *Scapteriscus vicinus* Latr which was introduced into the Southern States supposedly from Puerto Rico, probably in the ballast of ships

Torres, Ignacio L. 1927 El gorgojo del ñame del guineo (*Cosmopolites sordidus*) Rev Agr P R **19**(2): 56–58, 2 figs

A general popular account of the insect and its control in Puerto Rico

1928 Algo sobre algodon Sea Island Rev Agr P R **22**(9) 91–92 3 figs, March

Brief account of the cotton industry in Puerto Rico and of the more important insect pests and their control

1929 El cultivo de papas en Puerto Rico Rev Agr P R **24**(6) 239–242

It is stated on p. 241 that more or less damage was done to experimental plots of Irish potatoes at Cidra, Comerío, Barranquitas, Adjuntas, and Lares by mole crickets, [illegible] white grubs, the potato tuber moth *Phthorimaea operculella* and the cutworm *Xylomyges sunia*. good control of leaf feeders was obtained in an experimental plot at Lares with a copper lime [illegible] dust

1931 Campaña contra el gusano rosado del algodon Rev Agr P R **26**(11) 175–176, May

A radio talk to explain to cotton growers the bad situation with regard to the pink boll worm and to outline measures for its relief.

Tower, W V. 1907 Report of the entomologist and plant pathologist P R (Mayaguez) Agr Exp Sta Rept for 1906 pp. 25–28

This is Mr. Tower's first report. Brief notes on the status and control of insects attacking citrus, coffee and cane.

1908 *a* Report of the entomologist and plant pathologist P R (Mayaguez) Agr Exp Sta. Rept for 1907, pp 31–38.

Notes on insects affecting citrus, tobacco, vegetables, sugar cane and pineapples.

1908 *b* Control of the brown ant (*Solenopsis geminata* Fab)

and the mealy bug (*Pseudococcus citri* Risso) in pineapple plantations. P. R. (Mayagüez) Agr. Exp. Sta. Circ. 7:1–3.

The mealy bug is *Pseudococcus brevipes* Ckll. instead of *citri*.

1909. Report of the entomologist. P. R. (Mayagüez) Agr. Exp. Sta. Rept. for 1908, pp. 23–28.

Notes on insects affecting citrus, pineapples and coffee; Italian bees introduced.

1910. Report of the entomologist. P. R. (Mayagüez) Agr. Exp. Sta. Rept. for 1909, pp. 24–28.

Notes on insects affecting citrus, on white grub injury to cane, on cigarette beetle fumigation and on apiculture.

1911 *a*. Report of the entomologist. P. R (Mayagüez) Agr. Exp. Sta. Rept. for 1910, pp. 31–34.

Notes on guava insects, citrus fumigation, the coffee shade-tree ant and on apiculture; brief report on a trip to Cuba to study cane insects.

1911 *b*. Insects injurious to citrus fruits and methods for combating them. P. R (Mayagüez) Agr. Exp. Sta. Bul. 10, 35 pp., 5 pls. Also a Spanish edition of 36 pp. in 1912.

General account of the more important species present; the first comprehensive account for the Island.

1911 *c* Beekeeping in Porto Rico. P. R (Mayagüez) Agr Exp Sta. Circ 13:1–31 pp., 1 pl. Also a Spanish edition.

1912 *a* A study of the mosquitoes in San Juan, Porto Rico. P. R. (Mayaguez) Agr Esp. Sta. Circ. 14:1–23. Also a Spanish edition in 1913

1912 *b* Report of the entomologist. P. R. (Mayagüez) Agr. Exp. Sta. Rept. for 1911, pp. 32–36.

Notes on apiculture and on citrus and mango insects.

1912 *c*. Beekeeping in Porto Rico. First Ann Rept. P. R. Hort. Soc. for 1912, pp. 64–68.

Brief notes on the possibilities of developing a beekeeping industry in Puerto Rico and notes on the more important honey plants.

1920 *a*. Report of the entomologist. P. R. (Mayagüez) Agr. Exp. Sta. Rept. for 1918, pp. 15–17.

Mostly notes on apiculture.

1920 *b*. Report of the entomologist. P. R. (Mayagüez) Agr Exp. Sta. Rept. for 1919, pp. 21–25.

Notes on mosaic transmission tests and on honey plants; a citrus thrips population survey noted is especially interesting altho the species involved were, apparently, not determined; injury to oranges was noted in several places.

1921 *a*. Report of the entomologist. P. R. (Mayagüez) Exp Sta. Rept. for 1920, pp. 23–27.

Brief notes on apiculture, mosquitoes, cattle ticks and on scale insects of citrus.

1921 *b*. Mosquito survey of Mayagüez. P. R. (Mayagüez) Agr. Exp. Sta. Circ. **20**: 1–10 pp.

1922. Report of the entomologist. P. R. (Mayagüez) Agr. Exp. Sta. Rept. for 1921, pp. 23–26 (published as U. S. Dept. Agr., Office of Exp. Sta. Bul. 171)

Records trials of sugar cane mosaic transmission with *Sipha flava* and other insects; notes on cattle tick work and on apiculture.

1923. Report of the entomologist. P. R. (Mayagüez) Agr. Exp. Sta. Rept. for 1922, pp. 13–14.

A report on spraying experiments for the control of citrus scab.

1923. The cigar beetle. P. R. (Mayagüez) Agr. Exp. Sta. Agr. Ext. Notes No. 60, 1 p. (mimeographed).

Damage to cigars and to loose leaf tobacco in bales by *Lasioderma serricorne* F. in Puerto Rico is described and advantages of fumigation are pointed out.

1924 Report of the entomologist P. R. (Mayagüez) Agr. Exp. Sta. Rept. for 1923, pp. 11–15

Notes on fumigation for the cigarette beetle in tobacco factories, control of citrus insects, cotton insects and melon and cucumber insects.

Tracy, S. M. 1903. La cría del cerdo en el sur. Dept. Int. P. R., Neg. Agr. y Minas, Bol. Agr. 8. pp. 45–46.

A Spanish translation of U. S. Farmers' Bul. 100 "Hog raisng in the South," 1899, which includes a brief description of the hog louse and its control.

Tucker, C. M. 1924. The coconut bud-rot in Porto Rico. P R. (Mayagüez) Agr. Exp. Sta. Agr. Notes No. 2, 2 pp., 15th April.

Stated that insects are attracted to decaying buds and rotted

portions and are one of the means of disseminating the disease in Puerto Rico.

U. S. Dept. Agr., Fed. Hort. Bd. 1922. Service and Regulatory announcements, July–December 1921, No. 71, pp. 95–178. (Abs. in Rev. Appl. Ent. **10**: 595.)

Note on the extended infestation in Puerto Rico of *Pectinophora gossypiella* from which the U. S. is protected from introduction by the quarantine recently having been extended to Puerto Rico.

1925. Fruit and vegetable quarantine of Porto Rico. Notice of quarantine 58, 5 pp., May 27.

Anastrepha fraterculus, the West Indian fruit fly, and *Maruca testulalis*, the bean pod-borer, are specifically mentioned.

1926. Hawaiian and Porto Rican quarantine covering sand, soil or earth, with plants Notice of quarantine No. 60, 1 p., February 19.

To prevent the spread of Lachnosterna and several species of Termites no sand, soil or earth around the roots of plants may be moved from these countries into the U. S. except for experimental or scientific purposes, effective March 1, 1926.

U. S. Dep. Agr.. P. Q. C. A. 1929. [Administrative instructions concerning Mediterranean fruit fly quarantine.] Circ. Nos. **229** & **234**, 2 pp., multigraph, Washington, D. C.

No host fruit or host vegetable from Florida may be moved or reshipped to any of 18 southern or western states or to Puerto Rico.

Van Deusen, Elizabeth Kneipple. 1930. Famous Porto Ricans of the past Augustín Stahl P. R. School Rev **14**(5): 26–27

A biographical sketch of the foremost pioneer student of the natural history of Puerto Rico.

Van Deusen, R. J. and **E. K.** 1931. Porto Rico—A Caribbean Isle, 342 pp., many illustrations, New York.

A general history of Puerto Rico from prehistoric times to the present day. On p. 54 is a reference to the mosquito plague at Guánica in the year 1510.

Van Dine, D. L. 1911. (Cane insects). First report of the entomologist of the experiment station. Sugar Growers' Ass. P. R. Exp. Sta. Bul. 1, pp. 17–31. Also in Yearbook of Assn. Sugar Prod. P. R. for 1910–1911, pp. 43–57.

A general discussion of the more important sugar cane insects and their status in Puerto Rico.

1912 *a* Report of the entomologist Second annual report Sugar Prod Assn P R Exp Sta for the year 1911–1912, pp 15–22

Notes on the progress of investigations on various sugar cane insects.

1912 *b*. Daño ocasionado al jugo de la caña por el barreño del tallo o "borer". (*Diatraea saccharalis* Fab.) Est Exp Asoc Prod Azúcar P R Circ 1: 1–11 Also an English edition, same date and number of pages entitled Damage to sugar-cane juice by the moth stalk-borer"

1912 *c* Progress report on introductions of beneficial parasites into Porto Rico First Rept Bd Comm Agr P R for July 1, 1911–Jan, 1912, pp 31–47

Report on the preliminary studies in the U. S. and introduction from Illinois thru C. E Hood of *Tiphia* parasites of white grubs; copy of Hood's report is included; also a record of the introduction of the lady beetle, *Cryptolaemus montrouzieri* from Calif. for *Pseudococcus* spp.

1912 *d* The mango insect pests of Hawaii First Ann Rept P. R Hort Soc for 1912, pp 15–19 La Bandera Press, Mayagüez.

Notes on the principal mango insects of Hawaii presented for the information of growers in Puerto Rico

1912 *e* Mango insects in Porto Rico First Ann Rept P R Hort Soc for 1912, pp 20–22

Notes on the mango fruit fly (*Anastrepha* sp), a scale insect and a thrips

1913 *a* The introduction of parasites of may-beetles into Porto Rico Second Rept Bd Comm Agr P R for 1912–1913, pp. 36–48

The work referred to in the previous report is reviewed and that done since, including Wolcott's activities in Illinois and his West Indian trip to study sugar cane insects and their parasites, breeding notes on the introduced *Tiphia*.

1913 *b*. Report of the entomologist. Third Ann. Rept (Bul 5) Sugar Prod. Assn P. R. Exp. Sta., pp. 23–46.

1914 Informe del entomólogo. Bol 5, Est. Exp. Asoc. Prod.

Azúcar de Puerto Rico. (Tercer inf. anual), pp. 27–48. (The Spanish edition of the preceding.)

Includes a list of 30 sugar cane insects in Puerto Rico and a bibliography of 41 titles.

* 1913 c. Insects injurious to sugar cane in Porto Rico and their natural enemies. Jour. Bd. Agr. British Guiana 4(4): 199–203. April

According to Wolcott (see his "List" p. 14) this contains the same information as in Van Dine 1913 b and d. The volume may be No. 6. I have not seen this personally.

1913 d The insects affecting sugar cane in Porto Rico. Jour. Econ Ent 6: 251–257.

A brief summary of all the insects found affecting sugar cane during the two years entomological investigations have been in progress at the P. R Sugar Producers' Exp. Station; brief previous history.

van Leenhoff, J. W. 1906. Report of the coffee specialist. Diseases and insect pests. P. R (Mayagüez) Exp. Sta. Rept. for 1905, pp 46–47.

Brief notes on *Leucoptera coffeella*, *Saissetia hemisphaerica* and leaf weevils (*Lachnopus*).

1907. Report of the coffee expert. Diseases and insect pests. P. R. (Mayagüez) Agr. Exp. Sta Rept. for 1906, pp., 31–32.

Mostly a brief note on a fertilizer experiment for the control of the coffee leaf-miner with results apparently negative to date.

1908. Report of the coffee expert Diseases and insect pests P. R. (Mayagüez) Agr Exp Sta. Rept. for 1907, p 40.

Note on a borer; the leaf-miner fertilizer experiment referred to previously is reported successful.

van Volkenberg, H. L. 1929 a Report of the parasitologist. P. R. (Mayagüez) Agr. Expt. Sta. Rept. for 1927, pp. 28–31.

Several external parasites of domestic animals and poultry are recorded.

1929 b. Report of the parasitologist. P. R. (Mayagüez) Agr. Exp. Sta. Rept. for 1928, p. 36.

Screw-worm flies are reported as common and open wounds in animals are always liable to infestation by the maggots.

1930. Report of the parasitologist. P. R. (Mayagüez) Agr. Exp Sta Rept for 1929, pp 26–29

Notes on cattle tick eradication.

1931 Report of the parasitologist P R (Mayaguez) Agr. Exp Sta Rept for 1930 pp 38–40

Notes on the occurrence of a tapeworm cysticercoid in the dung beetle, *Ataenius stercorator* Fab and in the water beetle, *Tropisternus collaris* Fab

1932 Report of the parasitologist P R (Mayaguez) Agr Expt Sta Rept for 1931 pp 24 27 1 fig

Notes on various external parasites of livestock, including ticks, flies of various kinds, fleas and lice an interesting observation is that the water beetle *Tropisternus collaris* Fab is an intermediate, and apparently important, host of the thorny headed worm, *Macracanthorynchus hirundinaceus*, of swine

van Zwaluwenburg, R H. 1915 Report of the entomologist. P R (Mayaguez) Agr Exp Sta for 1914 pp 31–25

Notes on mole crickets, coffee leaf miner, coffee shade tree insects and on other miscellaneous insects and on honeybees

1916 *a* Report of the entomologist P R (Mayaguez) Agr Expt Sta Rept for 1915, pp 42–45

Notes on insects attacking coffee and coffee shade trees, vegetables and on white ants, the coconut rhinoceros beetle and several miscellaneous pests.

1916 *b* Notes on the life history of *Ecpantheria eridanus* Cramer Insec Ins Men **4** 12–17

The studies were made in Puerto Rico

1917 Insects affecting coffee in Porto Rico Jour Econ Ent. **10**(6) 513–517

A summary of the knowledge of this subject up to that time.

1918 *a* Report of the entomologist P R (Mayaguez) Agr. Exp Sta Rept for 1916, pp 25-28 1 pl

Notes on the cattle tick, mole cricket, may beetles, apiculture and miscellaneous insects

1918 *b* Report of the entomologist P R (Mayaguez) Agr Exp Sta Rept for 1917, pp 31–34

Life history data on the cattle tick, notes on a Phorid fly destructive to corn kernels and miscellaneous notes.

1918 *c*. The changa or West Indian mole cricket. P. R. (Mayagüez) Agr. Exp. Sta. Bul. **23**: 1-27 pp., 3 pls.

An excellent general account with extensive bibliography.

Van Zwaluwenburg R. H. and **Thomas, H. E.** 1918. Some means of controlling insects, fungi and other pests in Porto Rico. P. R. (Mayagüez) Agr. Exp. Sta. Circ. **17**: 1–30.

General account with control measures.

Van Zwaluwenburg, R. H. and **Vidal, Raphael.** 1918. Rearing queen bees in Porto Rico. P. R. (Mayagüez) Agr. Exp. Sta. Circ. **16**: 1–12, 5 figs. Also a Spanish edition.

Varas Catalá, Juan. 1922. Tabla por la que deberán regirse los ganaderos al preparar la solución arsenical con el concentrado Atlas cattle dip. Rev. Agr. P. R. **8**(3): 65–66.

Vickery, R. A. 1926. Observations on *Cirphis latiuscula* H. Sch. in the Gulf region of Texas. Jour. Agr. Res. **32**(12): 1099–1119, 3 figs., 14 refs.

Stated that this species is known in Tropical America, especially in Cuba and Puerto Rico as a pest of sugar cane and other large grasses.

Vidal, Rafael. 1916. Some of the needs of the Porto Rican Beekeeper. Gleanings in Beeculture **44**: 409-410, 1 fig.

Viereck, H. L. 1913. Descriptions of ten new genera and twenty-five new species of ichneumon-flies. Proc. U. S. Nat. Mus. **44**: (No. 1968): 555–568.

The following are described as new species from Puerto Rico: *Crassimicrodus fenestratus*, *Apanteles* (*Protapanteles*) *mayaguensis*, *Opius* (*Utetes*) *anastrephae*, *Eiphosoma* (*Brachixiphosoma*) *insularis* and *Cristolimorpha plesius*.

Voorhees, E. B. 1903. Cultivo del tomate en los Estados Unidos. Dept. Int. P. R., Neg. Agr. y Minas Bol. Agr. 15, pp. 44–45.

Brief general account of tomato insects in this Spanish translation of U. S. Farmers' Bul. 76 on "Tomato Growing," 1898.

Walsingham, Lord. 1892. On the Microlepidoptera of the West Indies. Proc. Zool. Soc. London for 1891, pp. 492–549, 1 pl. (41).

Includes a number of species specifically stated to occur in Puerto Rico; apparently none described as new.

1897. Revision of the West Indian Microlepidoptera, with descriptions of new species. Proc. Zool. Soc London for 1897. pp. 54–182

This brings the previous paper up to date.

Walton, W. R. 1912 A new species of Tachinidae from Porto Rico Proc Ent Soc Wash **14**(4): 198 200, 1 pl

Cryptomeigenia aurifacies, a parasite of May-beetles.

1913 New North American Tachinidae (Dipt) Ent News **24**(2): 49-51, pl. 3, figs. a-f

Eutrixoides jonesi as a new genus and species from Puerto Rico. another parasite of May-beetles.

1914 Four new species of Tachinidae from North America Proc Ent Soc Wash **16**(2): 93 95

Linnaemyia fulvicauda and *Compsilura oppugnator* as new species parasitic on *Cirphis latiuscula* H. S. from Puerto Rico.

Watts, R. L. 1903. Cultivo de la cebolla Dept. Int. P R, Neg Agr. y Minas. Bol. Agr 9. p. 27.

A Spanish translation of U S Farmers' Bul 39 "Onion Culture," 1896, which includes a brief account of the onion maggot and its control

Weise, J. 1885. Beitrag zur Chrysomeliden - und Coccinelliden-Fauna Portorico's Archiv für Naturgeschichte 51(1): 144–168 pl 8

The following species are described as new: *Lema nigripes* and *Cryptocephalus tristiculus*, p. 147, *krugi*, p 148, *stolidus*, p. 149, *perspicax*, p. 151 and *nothus*, p. 152: *Pachybrachys mendicus*, p. 153; *Metachroma antennalis*, p. 155; *Leucocera laevicollis*, p. 156; *Galerucella varicornis*, p. 157; *Disonycha pallipes*, p. 159; *Hermoeophaga cylindrica*, p. 160; *Megistops fictor*, p. 162; *Homophyla krugi*, p. 163; *Systena varia*, p. 164; *Octhispa loricata*, p. 166.

Wetmore, Alex. 1916. Birds of Porto Rico U S. Dept Agr. Bul 326: 1–140 pp, 10 pls Also published as Bul **15** Ins. Exp Sta. P R., same date

Contains a great deal of data on insects as the food of Puerto Rican birds.

Wheeler, Wm. M. 1908 The ants of Porto Rico and the Virgin Islands Bul Am Mus. Nat. Hist 24 (Art 6): 117–158, pls. 11 & 12.

Describes 8 new species and varieties.

White, W. H. 1916. The sugar-beet thrips. U. S. Dept. Agr. Bul. **421**, p. 2, 8 figs., 2 pls.

Records *Heliothrips femoralis* Reut. as occurring on sugar cane in Puerto Rico.

Wiedemann, C. R. W. 1830. Aussereuropaische zweiflügelige Insekten 2, pp. 41–42.

Sargus bicolor as a new species from Puerto Rico.

Wolcott, A. B. 1923. Two new speciesof West Indian Cleridae (Coleoptera). Am. Mus Novitates No. 59, 3 pp., 2 figs., February 14.

Callotillus crusoe as a new species from Puerto Rico.

Wolcott, Geo. N. 1913. Report on a trip to Demerara, Trinidad and Barbados during the winter of 1913. Jour. Econ Ent. **6**(2): 443 457 Reprinted in Third Ann. Rept. (Bul. **5**) Sugar Prod. Assn. P. R. Exp. Sta. pp 47–68. Also see "Informe sobre un viaje a Demerara, Trinidad y Barbados durante el invierno de 1913" in Bol 5, Est. Exp. Asoc Prod Azúcar de Puerto Rico (3er. Inf. Anual), p 49 71, 1914.

A detailed report on observations on the insects affecting sugar cane and their parasites in the places visited.

1915. Influencia de la lluvia y quemazón de la paja sobre la abundancia de *Diatraea saccharalis*. Est. Exp. Asoc. Prod. P. R Circ 7: 1 6, map (Also in English "The Influence of Rainfall and the Non-Burning of Trash on the Abundance of *Diatraea saccharalis*".)

1917. Report of the entomologist. Fifth Rept Bd Comm. Agr. P. R. for the period from 1st July, 1915 to 30th June, 1916.

Notes on quarantine enforcement and inspection, control of scales on citrus, tobacco flea beetles and their control, and a number of vegetable insects.

1921 *a*. Los comejenes de Puerto Rico. Est. Exp. Ins Circ **44**: 1–14, fig. 12.

General account of the more injurious termites of Puerto Rico and suggestions for their control.

1921 *b*. El caculo taladrador del tallo del cafeto (*Apate francisca* Fabr.). Est. Exp. Ins. Circ. **48**: 1–7, fig. 2.

General account of the coffee stem-borer and its control.

1921 *c* El minador de las hojas del café, *Leucoptera coffella* Stain. Est Exp Ins Circ **52** 1–12, fig 6

General account of the coffee leaf miner and suggestions for its control

1921 *d* The minor sugar-cane insects of Porto Rico Jour Dept Agr P R **5**(2)5–46, fig 19

1921 *e* Las plagas del cacao en Santo Domingo y algunas indicaciones para combatirlas Rev Agr P R 6(6) · 11–12

Mention that aphids and mealybugs are common in Puerto Rico as in Santo Domingo as well as in other Tropical countries

1821 *f* Annual report of the division of entomology Ann Rept Ins Exp Sta P R 1920–21 pp 47–49

Experiments in insect transmission of sugar cane mosaic by insects, notes on banana and coffee insects and on *Phthorimaea operculella* Zell, stated to be the most important insect of the year, injuring tobacco, potato tubers and egg plants

1922 *a* Los gusanos de la hoja del tabaco Est Exp Ins Circ **53** 1–15, fig 8 pl 1

Brief general account of the horn worm, leaf miner and cutworms of tobacco

1922 *b* Afidos de importancia economica en Puerto Rico Est Exp Ins Circ **59** 1–11 fig 9

Brief account of the [illegible] injurious [illegible] Rico

1922 *c* Vaquitas de importancia economica en Puerto Rico Est Exp Ins Circ **60** 1 20 fig 20

Brief account of the more important injurious weevils in Puerto Rico

1922 *d* Insectos que atacan los productores almacenados Est Exp Ins Circ **65** 1–8

Brief account of the principal insects attacking foods and stored products in Puerto Rico

1922 *e* Insect parasite introduction into Porto Rico Jour Dept Agr P R **6**(1) 5–20, fig 7

An excellent summary of the history and present status of parasite introduction

1922 *f* The influence of the variety of sugar-cane on its infestation by *Diatraea saccharalis* and other factors affecting

the abundance of the moth borer. Jour. Dept. Agr. P. R. **6**(1): 21–31, fig. 2.

An analysis of the various factors involved: rainfall, varieties and parasites.

1922 *g*. The insects of sugar cane in Santo Domingo. Jour. Dept. Agr. P. R. **6**(1): 32–37, pl. 1.

An annotated list of 32 species compiled from 5 months' observations by the author, notes made by Tower of Puerto Rico during a trip to the country and from determinations of collections from the Romana Central and from notes by E. G. Smyth of Puerto Rico. Some occur in Puerto Rico.

1922 *i*. The status of entomology in Porto Rico. Jour. Dept. Agr. P. R. **6**(2): 3–11. (Also either reprinted or abstracted in Sugar (Review) 26: 93, Feb., 1924, New York.)

A valuable summary of the history of entomological work in the Island and of the activities of the principal workers and agencies by which it has been accomplished.

1922 *j*. Informe de la estación experimental insular. Informe del departamento de entomología. Rev. Agr. P. R. **8**(2): 65–68.

Notes on several insects injurious during the year.

1922 *k*. Curso de instrucción a los maestros y agentes agrícolas (Entomología) Rev. Agr. P. R. **8**(3): 21–30.

1922 *l*. Informe sobre un viaje hecho a la región algodonera para observar las plagas de insectos que atacan al algodón Rev. Agr. P. R. **9**(3): 15.

1922 *m*. A reaction to a variation in light intensity by the coffee leaf miner. Ecology **3**(1): 86.

An observation indicating that both the moths and caterpillars of *Leucoptera coffeella* are remarkably sensitive to variations in subdued light intensities.

1922 *n*. The distribution of the pink bollworm of cotton, *Pectinophora gossypiella* Saunders, in Porto Rico. Jour. Econ. Ent. **15**(4): 313–314, map.

Presents a summary of the results of a survey made during the winter and spring of 1922.

1922 *o*. Informe anual de la división de entomología para el

año fiscal de 1921 a 1922. Inf. An. Est. Exp. Ins. P R., 1921–1922, pp. 55–60.

Notes on experiments in the control of white grubs and in insect transmission of cane mosaic and on coffee insects; several other injurious insects noted and reference is made to the discovery of the pink bollworm and the banana root-weevil during 1921.

1922 *p*. Tres cartas. Rev. Agr. P. R. **9**(5) : 39–40.

Letters concerning beetles which injure the sweet potato, and the cotton leaf worm.

1923 *a*. El cucubano, *Pyrophorus luminosus* Illiger. Est. Exp. Ins. Circ. **50** : 1–8, 3 figs.

Life-history, distribution and economic importance; beneficial habits of larva, which devours large numbers of white grubs (*Phyllophaga* spp.).

1923 *b*. The distribution of the pink bollworm in Porto Rico. Ins. Exp. Sta. Circ. **85** : 1–7, 1 map.

Brief account of spread from time of discovery and results of a survey made during the winter and spring of 1922–1923.

192 *c*. "Insectae Portoricensis," a preliminary annotated check-list of the insects of Porto Rico, with descriptions of some new species. Jour. Dept. Agr. P R. **7**(1) : 1–313, 2 pls. (Actual date of publication, March 5, 1924.)

About 2,300 species listed, with localities, food-plants, dates and much bibliographical data; 32 species are described as new.

1923 *d*. Entomological papers. The food of Porto Rican lizards. Jour. Dept. Agr. P. R. **7**(4) : 5–37. (issued August, 1924.)

1923 *e*. Entomological papers. First supplement to Insectae Portoricensis. Jour. Dept. Agr. P. R. **7**(4) : 38–43. (Issued August, 1924.)

Corrections and additions.

1923 *f*. An important new pest of beets in Porto Rico Jour. Econ. Ent. **16**(6) : 459–460.

Notes on the injury, abundance, food-plant and natural enemies of *Disonycha laevigata* Jacoby.

1924 *a*. Entomología Económica Puertorriqueña. Est. Exp. Ins. P. R. Bol. **32** : 1–176, 12 pls. 97 figs.

General account of the more important economic insects in Puerto Rico with control measures. A very useful paper.

1924 *b*. Hormigas. Est. Exp. Ins. P. R. Circ. **75**: 1–11.

General account of the more important injurious ants in Puerto Rico and their control; 45 species of ants known to occur in the Island.

1924 *c*. Annual report of the division of entomology for the fiscal year 1922–23. Ins. Exp. Sta P. R. Rept for 1922–1923, pp. 51–57.

Notes on white grub and sugar cane mosaic transmission experiments; coffee shade tree insects and bees in coffee groves, banana root borer, tobacco leaf-miner, pink bollworm, cotton leaf-worm and on other cotton insects.

1924 *d*. Annual report of the division of entomology, fiscal year 1923–24. Ins. Exp. Sta. Rept for 1923–24, pp 88–103.

Notes on white grub control, on the coffee shade-tree ant and its control, on pink bollworm, banana root borer, termites and several other injurious insects.

1925 *a*. The comparative resistance of woods to the attack of the termite, *Cryptotermes brevis* Walker Ins. Exp Sta P. R. Bul. **33**: 1–15.

A list of the different kinds of woods arranged in order of their comparative resistance to attack shows that cypress is absolutely resistant and mahogany somewhat less so

1925 *b* On the amount of food eaten by insects Jour Dept. Agr P R **9**(1): 47–58

Feeding experiments with several species of insects carried on in Puerto Rico.

1926 Notes on the insects of the sea-grape, *Coccoloba uvifera* (L.) Jacq. in Porto Rico and adjacent countries Bul Ent. Res **17**(1): 49–52

1927. Common insect pests prefer other host plants in Haiti. Jour. Econ. Ent. **20**(2): 429–430

Systena basalis Duv. stated to be usually on tobacco in Puerto Rico but on cotton in Haiti and *Nezara viridula L.* but once recorded as damaging tobacco in Puerto Rico and observed also commonly in a field in Haiti altho it occurs mainly on cotton in the Lesser and on tomatoes and peppers in the Greater Antilles.

1928. The maybeetles of Haiti (Scarabeidae: Coleoptera). Proc. Ent. Soc. Wash. **30**(2): 21–29.

The abundance of *Phyllophaga* in Puerto Rico is referred to on page 21.

1929 *a*. The mystery of *Alabama argillacea*. Am. Nat. **63**, (684) : 82–87.

> "In the scattered cotton fields of Puerto Rico, *Alabama* sometimes appears in destructive numbers but in other years is not to be seen."

1929 *b*. Notes on the life history of *Exophthalmus quadrivittatus* Oliv. (Coleoptera). Proc. Ent. Soc. Wash. **31** (2) : 21–26.

> Mention of injuries by *Diaprepes* in Puerto Rico is made on page 21.

1929 *c*. Weather and the non-burning of trash in borer control in Porto Rico. Trans. 4th Int. Congress Ent. **2** : 62–64.

> Extensive observations show that infestation by the sugar cane borer, *Diatraea saccharalis* Fab. is inversely proportional to the amount of rainfall and worse where the trash is burned due to destruction of parasites.

1931. The infestation of young okra pods by the pink bollworm in Porto Rico. Jour. Dept. Agr. P. R. **15** (4) : 395–398.

1932 *a*. Insect conditions in Porto Rico during February, 1932. Ins. Pest Surv. Bul. **12** (2) : 76, April 1.

1932 *b*. On methods of determining borer abundance in cane fields. Proc. Fourth Congress Int. Soc. Sugar Cane Techs. (Preprint Bul. **88** : 1–2), San Juan, P. R.

> Experiments carried on in Puerto Rico are referred to.

1932 *c*. Insect conditions in Puerto Rico during July, 1932. Ins. Pest Surv. Bul. **12** (6) : 293.

> Notes on the cottony cushion scale and lima bean pod-borers.

1932 *d*. Insect conditions in Puerto Rico during August, 1932. Insect Pest Surv. Bul. **12** (7) : 338, September 1.

> A note is included on the status of the cottony cushion scale, *Icerya purchasi* Mask., as of the middle of August.

1932 *e*. The effect of the hurricane of San Cyprian on insects in Puerto Rico. Ins. Pest Surv. Bul. **12** (9) : 409–410.

> Some insects present in normal numbers and others reduced; notably among the latter is the cottony cushion scale, which however was undoubtedly considerably extended in its distribution.

Wolcott, G. N., More, J. D. and Seín Jr., F. 1921. La oruga rosada de la cápsula del algodón en Puerto Rico. Est. Exp.

Ins. P. R. Circ. 63, 12 pp., 3 figs. Reprinted under the same title in the Agricultor Puertorriqueño **11**(7): 7–8, 28, 3 figs., 1921.

General account of the discovery, distribution life-history, and control of the pink bollworm of cotton in Puerto Rico.

Wolcott, G. N. and **Seín Jr., F.** 1921. La lapa del tabaco y otras siembras. Est. Exp. Ins. P. R. Circ. **51**.

General account of the damage and control of the slug, *Veronicella occidentalis* Guild. on tobacco and other crops in Puerto Rico.

Wolcott, G. N. and **Seín Jr., F.** 1922. Los caculos cornudos o los escarabajos rinocerontes de Puerto Rico. Est. Exp. Ins. P. R. Circ. **53**: 1–13, 4 pls.

Brief general account of *Strataegus quadrifoveatus* Beauv. and *S. titanus* Fab.

1931. La oruga rosada de la cápsula del algodón en Puerto Rico. Est. Exp. Ins. P. R. Circ **95**: 1–13, 4 figs.

General account of the pink bollworm in Puerto Rico and suggested control measures.

APPENDIX

As a partial guide or index to this bibliography the following list of authors is given. The names are grouped largely under the orders of insects, altho several general subjects such as malaria, apiculture, and plant quarantine are included. Altho it will be found by turning to the references cited under these authors that the papers are mostly of a systematic nature, the names of authors of some of the more important economic papers have also been included, especially where a paper deals with a single species. Where no date follows an author's name it means that there is either only a single reference listed for that author or that all the references by that author deal with the group of insects or subject designated.

APICULTURE

Anonymous 1928 *a*, 1928 *b*; Abad, J.R.; Baldorioty de Castro; Brenner; Colón, E. D., 1930; Cuevas Zequeira; Holmer & Little; Iches; Leo u; Phillips; Sein, 1923 *b*; Snyder, T. G.; Tower, 1911 *c*, 1912 *c*, 1920 *a*, 1921 *a*; Van Zwaluwenburg & Vidal; Vidal.

ARACHNIDA

Banks, 1901, 1917; Chamberlin, 1917, 1922 (millipedes), Cotton, 1917 *c*; Koch; Lutz; Petrunkevitch; Seely.

COLEOPTERA

Anonymous, 1932; Aube; Ballou, 1913, 1916; Baly; Barrow, Blake; Boheman; Bovel; Bryant; Catoni, 1932 *e*; Champion; Chapin; Chapuis; Chevrolat, L. A. A.; Chevrolat, M. A.; Clark, Hamlet; Cotton, 1917 *b*, 1918 *b*, 1918 *d*; Crespo, 1920; Danforth, R. E.; Erichson; Erichson in Germar; Fauvel; Fischer; Fisher; Fletiaux; Gahan, C. J.; Gerstaecher; Gómez; González Ríos 1922; Hutson; Illiger; Jacoby; Jones, 1915 *c*; Kolbe, 1907, 1910; Lacordaire; Leng & Mutchler; Leonard, *1930 *b*, 1931 *c*; Leveille; Lewis; López Tuero; Mäklin; Marshall; Montgomery & Bragdon; More, 1921 *a*, *b*, *c*; Moser; Mutchler; Notman; Ochs; Pierce, 1915, 1918; Quedenfeldt; Quintanilla; Reitter; Ritchie; Rivera; Sasscer, 1921, Sein, 1923 *c*, 1929, 1931 *b*, *c*; Sharp; Sicard; Smyth,

1917 *b*, 1918, 1920 *a*; Suffrian; Torres, 1927; Tower, 1923, 1924; Weise; Wolcott, A. B.; Wolcott, G. N., 1921 *b*, 1922 *c*, 1923 *a*, *b*, 1928, 1929 *b*; Wolcott & Seín, 1922.

DIPTERA

**Aldrich; Alexander, Bigot; Bradt; Coquillett; Cresson Jr.; Curran; Dickmans, 1927 *a*; Dyar, 1907, 1924, 1928, Felt; Frost; González Ríos, 1923; Gundlach; Hoffman, 1925, 1927; Knab; Leonard & Sein, 1931; Loew; Macquart; Malloch; M. A. M.; Melander; Osten Sacken, Parker; von Roeder; Smyth, 1919 *h*, *i*.
lander; Osten Sacken; Parker; von Roeder; Smyth, 1919 *h*, *i*; Wiedemann; Walton**

HEMIPTERA

Barber, Barber & Bruner, Cotton, 1917 *a*; Drake; Gundlach, Harris; Leonard, 1931 *b*, 1932 *c*; Leonard & Mills, 1931 *b*.

HOMOPTERA

Catoni, 1923 *d*; Cockerell, 1895; Cotton, 1917 *d*; Davis; Dozier, 1925, 1926 *b*, 1927 *a*, *b*, 1931, Fernald; Ferris, Funkhouser; Gibson; Gundlach; Hernández, Hottes & Frison; Jones, 1915 *a*, 1917 *a*; Leonard, 1930 *a*, 1932 *l*; Mari; Marlatt, 1908; McAtee; McClelland & Tucker; Menéndez Ramos, Morrison; Muir, 1918, 1924; Muir & Giffard; Osborn; Pergande & Cockerell; Quaintance; Quaintance & Baker; Sasscer, 1920; Teague; Wolcott 1922 *b*, 1932 *d*

HYMENOPTERA

Ashmead; Barret, 1904; Berger, 1921; Bishoff, Cockerell, 1910, 1919; Crawford; Cresson, Dewitz, 1881; Díaz; Dodd; Dozier, 1926 *a*, *c*, 1932 *a*, *b*; Gahan, A. B; Girault; Gundlach; Herrera, Hooker, 1912; Leonard, 1933 *b*; Mann; Muesebeck; Rohwer; Myers, 1931 *b*; Rohwer; Tower, 1908 *b*; Van Dine, 1913 *a*; Viereck; Wheeler; Wolcott, 1925 *a*.

ISOPTERA

Banks, 1919; Banks & Snyder; Crespo, 1919, Snyder, 1923, 1924; Wolcott, 1921 *a*, 1925 *a*.

LEPIDOPTERA

Aurivillius etc.; Box, 1931; Brown; Chittenden; Clark, B. Preston; Dewitz, 1877 *a*, *b*; Dyar 1922; Forbes; Forbes & Leonard; Gundlach, Hampson; Holloway; Holloway, Haley & Loftin; Hol-

loway & Loftin; Jones, 1913, 1915 *b*, 1917 *b;* Jones & Wolcott; Klotz, A. B.; Langston; Lathy; Leonard & Mills, 1931 *a;* Leonard & Sein, 1932; Linnaeus; Medina; Mills & Leonard; Molinary Sales; More, 1931 *d;* Möschler; Pagenstecher; Pastor Rodríguez, 1931 *a*, *b:* Rothschild; Rothschild & Jordan; Saavedra; Schaufuss; Sein, 1926, 1929 *c*, *d*, 1930 *b*, *d*, *e*, 1931 *a*, 1932 *b;* Sepúlveda; Smyth, 1916, 1917 *a*, 1920 *c;* Torres, 1931; U.S D.A., Fed. Hort. Bd. 1922; Van Zwaluwenburg, 1916 *b;* Vickery; Walsingham; Wolcott, 1915, 1921 *c*, 1922 *a*, *f*, *m*, *n*, 1923 *b*, 1929 *a*, *c*, 1931, 1932 *b;* Wolcott, More & Sein; Wolcott & Sein, 1931.

MALARIA (Including Mosquitoes)

Anonymous, 1925, 1926, 1927 *c*, *d*, 1928 *c*, 1929; Bastón; Earle; Earle & Arbona; Hoffman, Marin & Burke; Howard, Dyar & Knab: Dyar, 1907, 1924; Johnson; King; Kudo; Ludlow; McKinley; bard; Saussure; Sein, 1923, Thomas; Van Zwaluwenburg, 1918 *c*.

NEUROPTERA

Gundlach; Kolbe, 1888.

ODONATA

Gundlach; Klotz, Elsie B.

ORTHOPTERA

Barrett, 1902; Brunner von Wattenwyl; Brunner von Wattenwyl & Redtenbacher; Burmeister; Caudell; Crossman & Wolcott; Dohrn; Gundlach; deHaan; Hebard; Moore; Rehn & Hebard; Saussure; Sein, 1923; Thomas; Van Zwaluwenburg, 1918 *c*.

PLANT QUARANTINE

Anonymous, 1911, 1913, 1915, 1920, 1921, 1923, 1924; Catoni, 1921 *i*, 1922 *d*, 1924; Crespo & Catoni; Faxon & Trotter; Smyth, 1919 *a;* Stevenson, 1918 *a;* U.S.D.A., Fed. Hort. Bd ; U.S.D.A., P.Q. & C.A.

SERICULTURE

del Campo; Sein, 1928; Colón, 1930.

SIPHONAPTERA

Carrión; Cox, Carrión & Fox; Dickmans, 1927 *b*

STREPSIPTERA

Pierce, 1914.

THYSANOPTERA

Dozier, 1926 *d*; Hood; Leonard, 1932 *c*: Morgan; Russell; **White.**

THYSANURA AND COLLEMBOLA

Folsom; Sein, 1930, *b*.

VERTEBRATES (Birds, Toads & Lizzards)

Dexter; Anonymous, 1913 *a*; Danforth, S.T., 1926 Leonard, **1933 *a*;** **Rosenfeld**, 1925 *a*; Sein 1927; Smyth, 1920 *b*; Wetmore; **Wolcott, 1923 *d*.**

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NOTES ON INSECT CONDITIONS IN PUERTO RICO FOR THE FISCAL YEAR, JULY 1931 THRU JUNE 1932

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This constitutes the third annual report by the writer on insect conditions in Puerto Rico. The first, for the fiscal year of 1929–1930, was published as part of the Report of the Division of Entomology in the Rept. Ins. Exp. Sta. P. R. for 1929–30, pp. 110–123, 1931. The second appeared in the Jour. Dept. Agr. P. R. 16(2): 121–144, 1932. These two, together with the present paper, constitute Insect Pest Survey reports for the three years covered by them. During this time the writer was acting as an official Collaborator of the Insect Pest Survey of the United States Bureau of Entomology.

Altho this third and last report by the writer includes notes on the occurrence and status of more insects on more food plants than the others, it still does not pretend to present anything like a complete picture of the activities or occurrence of even all of the more important injurious insects of the leading economic plants of the Island. Desirable as such a record would be, especially if followed out from year to year, it is impossible of accomplishment without the expenditure of much more time and money for travel and a greater number of competent observers than we have so far been able to obtain.

The accumulating, recording and arranging of even so comparatively few observations has necessitated the active help of a number of specialists. Most of the determinations or verifications of species unknown or doubtful to the writer have been made by the several well-known taxonomists at the U. S. Bureau of Entomology. In most cases this is indicated along with the individual records, as are also the names of certain other specialists not officially connected with the Bureau. The writer is indebted to Mr. Richard Faxon and his associates Messrs. Mills, Anderson, Harley and Oakley of the San Juan office of the Federal Plant Quarantine and Control Administration. All of these have obtained many records thru their official observations. The identifications of this material are by the special-

ists in Washington. The names of collectors or observers are indicated for the most part by their initials as follows:

C.G.A. = Anderson	R.G.O. = Oakley
R.F. = Faxon	A.S.M. = Mills
A.G.H. = Harley	F.S. = Seín, Jr.
M.D.L. = Leonard	G.N.W. = Wolcott

Dr. W. T. M. Forbes of Cornell University has assisted in completing the notes on some of the Lepidoptera heretofore little known as far as published records were concerned. Prof. C. R. Crosby also of Cornell, has given much appreciated help in facilitating the preparation of the manuscript for publication.

ALFALFA

Dichomeris piperatus Wlsm., an alfalfa leaf-tyer, was destructively abundant during July at Isabela, rendering the alfalfa unfit for feeding in one patch (G.N.W.). In August the leaf-tyer was found to be rather badly infesting a small experimental patch at Maleza in the municipality of Aguadilla; this is in a rather isolated section containing many hat palms and little farming has been done there; the occurrence of the insect here in injurious numbers at some considerable distance from the only other nearest alfalfa grown at the Isabela Sub-station again raises the question as to what the natural leguminous food-plant really is (G.N.W.).

Prodenia ornithogalli Guen., the velvety cutworm, was abundant during July at Isabela attacking a wide variety of hosts including alfalfa, crotalaria and tomatoes, besides numerous weeds (G.N.W.).

Thermesia gemmatilis Hüb., the velvet bean caterpillar, was abundant on the leaves of alfalfa and sword beans at Isabela during July (G.N.W.).

Reuteroscops uvidus Dist., A Mirid bug (H. G. Barber det.) was reported as infesting in small numbers the leaves and flowers of alfalfa at the Demonstration Farm at Arecibo on June 7 (C.G.A.). It was also collected by sweeping weeds at Santurce, June 29 (C.G.A., H.G.Barber det.).

ALGARROBO (*Hymenaea Courbaril* L.)

Myelois decolor Zell. (Pyralidae, C.Heinrich det.). 4 larvae found in 1 out of 6 pods examined at the Demonstration Farm at Arecibo

Stephanoderes buscki Hopk. (Scolytidae, M.W.Blackman det.) heavily infesting 6 pods examined at the Demonstration Farm at Arecibo on Mar. 8 (C.G.A.). Not in Wolcott's "List."

ANNONA SPP.

Saissetia hemispherica Targ. (Morrison det.) lightly infesting the leaves of a corazón tree (*A. reticulata*) at Corozál, Feb. 9 (C.G.A.).

Bephrata cubensis Ashm., a Eurytomid, (Muesebeck det.) infesting 1 out of 4 fruits examined at Villalba, Oct. 27 (C.G.A.).

Pseudococcus nipae Mask. (Morrison det.) lightly infesting the foliage of a tree at Corozál, Feb. 9 (C.G.A.).

Pseudoaonidia articulatus Morg. (Morrison det.) 3 out of 14 fruits infested at Ponce, Jan. 8 (R.G.O.).

Empoasca n. sp. related to *minuenda* Ball (P.W.Oman det.) breeding in moderate numbers thruout the year on the foliage of 4 trees of *A. diversifolia* at the Station grounds at Río Piedras (M.D.L.).

Patara albidula Westw. (Fulgoridae, P.W.Oman det.). A few adults on the leaves of the above trees, May 20 (A.S.M.).

?*Hyaliodes* n. sp., (Miridae, H.H.Knight det.) bred more or less continuously thruout the year on the foliage of the 4 *Anona diversifolia* trees at the Station; both adults and nymphs in all stages could always be found in small to moderate numbers upon examination of the leaves; the nymphs are whitish and somewhat powdery in appearance; the eggs are undoubtedly inserted in the leaf petiole or in the mid-rib but a search was not made to determine this point. The insect was also noticed thruout the previous year which was the first time it had been reported from Puerto Rico.

AVOCADO

Pseudococcus nipae Mask. (Morrison det.) so badly infested the leaves and twigs of a small tree at Mayagüez on Dec. 12 that it was practically dead (A.G.H.).

Empoasca minuenda Ball (P.W.Oman det.) A moderate number of adults and nymphs found feeding on the leaves of a tree at Santurce on Mar. 1 (A.S.M.).

BANANA

Cosmopolites sordidus Germ., the banana root-weevil, has apparently been about as injurious as during the past year. It of course also affects plantains to which it often seems to do somewhat more damage than to bananas.

Telephanus pallidulus Chevr., a Cucujid, (W.S.Fisher det.). 1 adult was found in a decayed flower-stalk at Bayamón, May 15 (C.G.A.).

Bothriocera venosa Fowl., (P.W.Oman det.) a Fulgorid; small number of adults found on the leaves of 5 plants at Bayamón, Apr. 8 (C.G.A.).

Homophysa dolotalis Möschler (W. Schaus det.). A small number of adults of this Pyralid on the 5 plants mentioned above. It was also taken at light in Bayamón, May 15 (Schaus det., C.G.A.). Apparently previously recorded only from the type material, but Dr. Forbes found the species common and apparently general in 1930.

BEAN (LIMA & STRING)

Tetranychus sp., a mite (H.E.Ewing det.), was found infesting the leaves in most lima bean fields at Loíza examined during January; a few of the leaves had turned yellowish but the damage was only slight (A.S.Mills).

?*Hyaliodes* n. sp. a Mirid (H.H.Knight det.) generally distributed during the end of August in moderate numbers on the underside of the leaves of a small patch of pole limas at the Station in Río Piedras; no nymphs were present; adults also on a small adjoining patch of okra. Both plants were only 25–30 yards away from 4 *Anona diversifolia* trees on which the bugs were breeding.

Agromyza inaequalis Mall. a bean leaf-miner (C.T.Greene det.) infesting with blotch mines practically all the leaves in a small garden patch of limes in Río Piedras, Jan. 15 (R.F.). Blotch mines in bean leaves have been observed in various places thruout the year in moderate numbers and it is presumed that they are made by this species.

Aphis rumicis L. in considerable numbers on a small patch of pole limas at the Station at Río Piedras early in Sept. (M.D.L.) and lightly infesting a 2-acre patch of limas at Loíza, Nov. 6 (A.S.M.; P.W.Mason det. both records).

Megoura viciae Kalt., an aphid (P.W.Mason det.) lightly infested lima bean pods near Río Piedras Feb. 26 (R.F.). Apparently not previously reported from P. R.

Myzus probably n. sp., an aphid (P.W.Mason det.) moderately infesting a patch of string beans at Adjuntas, Mar. 21 (R.G.O.).

Pseudococcus virgatus Ckll. (Morrison det.) lightly but generally infesting a small patch of pole limas at the Station at Río Piedras Sept. 8 (M.D.L.) and lightly infesting the pods of limas at Loíza,

Agallia albidula Uhler, a leafhopper (P.W.Oman det.) lightly infested the leaves of lima beans, cassava melon and tomatoes at Loíza, Nov. 6 (A.S.M.).

Thyantor perditor Fab., a Pentatomid (H.G. Barber det.). Adults in moderate numbers on the leaves of a 3–acre lima bean patch at Loíza, Feb. 7 (A.S.M.).

Lachnopus curvipes Fab., (L.L.Buchanan det.). Several adults of this weevil found resting on plants in a 1-acre patch of limas at Vega Baja, Nov. 24 (A.S.M.).

Laphygma frugiperda A&S. (W Schaus det.) lightly infested the pods in a 1-acre patch of limas at the Substation at Isabela, Jan. 12 (C.G.A.).

Phytometra oo Cramer, a Noctuid (W. Schaus det.), lightly infested a small garden patch of limas at Río Piedras, Jan. 15 (C.G.A.).

Nezara viridula L. (H.G.Barber det.) moderately infesting the leaves and pods in an acre of limas at Río Piedras, Dec. 12 (A.S.M.); *Nezara viridula* L. occurred in small numbers of adults on the leaves of a 3-acre patch of lima beans at Loíza, Feb. 7 (A.S.M., H G.Barber det.).

Ellipes minuta Scudder, a Gryllid, (A.N.Caudell det.) found on a lima bean leaf in a small patch at Vega Baja, Nov. 24 (A.S.M).

Cycloneda limbifer Csy. (E.A Chapin det.) on a leaf in a small patch of limas at Río Piedras, Jan 16 (A.S.M.).

Carpolonchaca pendula Bezzi (Sapromyzidae, Aldrich det). A few larvae, from which adults were reared, in the pods in a hamper of limas at Isabela, Mar. 24 (C.G.A.). Apparently new to P. R.

Callosobruchus chinensis L. (H.S.Barber det.) found in small numbers in lima beans grown in Ponce, and kept in the office, May 25 (R.G.O.). See also under "Miscellaneous."

Corythucha gossypii Fab. was apparently generally distributed and more or less injurious to lima and string beans as usual thruout the year.

Empoasca fabalis DeL., the common bean leafhopper was generally distributed and present in its usual numbers thruout the year, often doing much damage to plantings during the drier periods, especially where they were unsprayed.

Lamprosema indicata Fab, the bean leaf-webber, was undoubtedly more or less injurious wherever beans were grown; it moderately infested pole limas at the Station during July and August but seemed to increase somewhat so that it was often doing considerably injury to all lima bean fields examined in Nov., Dec. and Jan. at Río Pie-

dras, as well as at Vega Baja, Loíza and Isabela. The moths were fairly common at light Sept. 25–27 at Puerto Real, Vieques Id. (M.D.L.).

Larvae of a Eulophid, *Grotiosmyia nigricans* How. (Muesebeck det.) found feeding on larvae of *Lamprosoma indicata* F. at Río Piedras on Jan. 15 (C.G.S.). Apparently not before recorded from Puerto Rico.

Goniurus proteus L., the bean leaf-roller, was also general but observations would indicate only light to moderate damage to limas at Río Piedras, Cidra (1 larva out of 100 plants examined by Mills) and Loíza.

Ceratoma ruficornis Oliv., a bean leaf-beetle, was present to some extent in a number of fields examined; it was reported as moderately infesting a 2-acre field of limas at Loíza on Jan. 8 and lightly infesting a 1-acre field at Río Piedras on Jan. 1 (A.S.M.).

Diabrotica graminea Baly, was undoubtedly general thruout the year as has been the case the past few years; it did considerable damage to the blossoms and leaves of pole limas at the Station and was reported as doing considerable damage also to snap beans at Orocovis on Feb. 2 by Mills.

Bean pod-borers. The comparative abundance of the 3 lepidopterous pod-borers most commonly found in lima and string beans was somewhat different than during the previous year. A report prepared by Messrs Faxon and Mills of the P.Q. & C.A. office in San Juan, altho it covers primarily the shipping season for green beans to the States—Nov. 1 to Mar. 31—fairly well summarizes the situation for the period of the whole fiscal year; it is as follows:

"*Fundella cistipennis* was usually present in small numbers in lima beans that were being shipped to the States. In previous seasons *Etiella zinckenella* Treit. appeared to be more prevalent than Fundella, but this season the situation was reversed as Fundella larvae were found to be more frequently in the pods of lima beans than either *Maruca testulalis* Geyer or *Etiella zinckenella*. The infestations of *Fundella cistipennis* were light, the highest being 3 per cent found in a hamper from Isabela. It was found to be present in shipments from Loíza, Vega Baja, Arecibo, Isabela and Adjuntas. Fifteen collections were forwarded to Washington for determination and many more could have been sent from other shipments. *Etiella zinckenella* was found only in 3 shipments of lima beans and 4 of gandules (pigeon peas)."

"*Maruca testulalis* was difficult to find until January, 1932 and

usually light. This was particularly true of gandules as only one interception was made in cull pods at Arecibo, altho hundreds of boxes were shipped to the States. Practically the only serious infestation in lima beans was found at Cidra, Feb. 26, where 11 per cent of the pods in a 3-acre field of bush limas were infested with Maruca larvae. Sixteen collections were sent to Washington for determination from beans grown at Loíza, Río Piedras, Vega Baja, Arecibo, Isabela, Cidra and Cayey."

It is interesting to note that only 1 moth of *Etiella zinckenella* was taken by the writer during three nights of collecting at light at Puerto Real, Vieques Id., Sept. 25–26, year.

An adult of *Microbracon thurberiphagae* Mues. (Muesebeck det.) reared from a larva found on a larva of *Maruca testulalis* Geyer in a hamper of lima bean pods from Vega Baja, Mar. 24 (C.G.A.). Three larvae of this parasite were also found infesting 1 out of 20 larvae of *Maruca testulalis* in lima bean pods at Cidra, Feb. 2 (A.S.M.). The first record for Puerto Rico; Bruner has recently recorded it from Cuba from the same host.

Beet

Disonycha laevigata Jacoby was observed lightly infesting a small patch of beets at Jayuya on June 14 (R.G.O.) but was undoubtedly generally distributed and injurious as usual to beets, swiss chard and related crops. (See also "Micellaneous").

Bidens pilosa radiata

Thrips abdominalis in moderate numbers in the flowers at Río Piedras on May 31 (A.S.M.; J.R.Watson det.).

Protalebra brasiliensis DeL., known to be a minor pest of sugar cane, continued to be abundant thruout this past year as during the previous one on all patches of the weed at El Morro in San Juan. It seemed to be very scarce if at all present at the Station in Río Piedras on the same food-plant.

Books

Rhizopertha dominica Fab. (*R. pusilla* Fab. is a synonym, A.J. Mutchler det.) according to Dr. Wm. A. Hoffman has done considerable damage to the books in the library of the School of Tropical Medicine thruout the year and for a couple of years previous. It is a cosmopolitan Bostrychid beetle injurious to lumber.

Bougainvillia

Orthesia insignis Douglas was reported as badly infesting a large vine at a home in Santurce on Apr. 20 and on Apr. 22 specimens were received from Bayamón with the statement that an unidentified tropical ornamental was rather badly infested.

Cabbage

Plutella maculipennis Curtis, the diamond-back moth, was observed in a number of places and was presumably as common and injurious as formerly.

A slug, *Veronicella occidentalis* Guilding, reported as doing considerable damage to cabbage, but also eating holes in green tomato fruits in a 1-acre garden planting at Trujillo during April.

Corythaica planaris Uhl., the eggplant lace-bug, was found in small numbers, adults, in a planting at Ponce on May 14 (R.G.O., H.G.Barber det.).

Cacara tuberosa (Lam.) Britton

Alysia analis Cress. was found on several plants at Ponce on June 28 (R.G.O., Muesebeck det.).

Canna

Calpodes ethlius Cramer, the canna leaf-roller, became destructively abundant during July on a number of plants at Isabela, averaging 1 or 2 larvae per plant (G.N.W.); it was observed in several other localities also.

Frankliniella insularis Franklin. See under "Rose" for note on damage to canna blooms.

Carrot

Systena basalis Duv. was observed in large numbers on the leaves in a 1/10-acre planting at Jayuya on June 14 (R.G.O., H.S.Barber det.).

Cashew nut (*Anacardium occidentale* L.)

Selenothrips rubrocinctus Giard, the red-banded thrips, defoliated several trees at Río Piedras in September and was again observed infesting the new foliage on the same trees the following February; in April a tree in another place near Río Piedras was badly infested

Cassava

Saissetia oleae Bernard so badly infested several considerable sized plantings from 6 months to 1 year old at the Manicomio near Río Piedras the latter part of July that many of the plants were entirely devoid of leaves and in a dying condition; several branches submitted for identification were badly encrusted with the scales in all stages of growth (S.Molinary).

An unidentified *whitish scale* was also present in the above infestation but apparently not as abundant as the other altho one of the branches brought in was badly infested.

Lonchaea chalybea Weid., the cassava shoot-borer, was received under date of Oct. 2 from the Agricultural Agent at Bayamón who stated that for some little time the insect had been very common in all the plantings in the district and had considerably reduced the yield.

Cryptosephalus tristiculus Weise, a Chrysomelid, (H.S.Barber det.), was found, 1 adult, on a leaf of one plant Apr. 29 (C.G.A.) at Lares.

Aphodius lividus Oliv. was found, 2 adults, on a plant at Santurce on June 29 (C.G.A., H.S.Barber det.).

Red-spiders, *Tetranychus* sp., were more or less injurious as usual, especially during the drier periods.

Cassia siamea

Asterolecanium pustulans Ckll. was observed to be badly infesting several ornamental trees at the Director's home on the Station grounds on May 6 at Río Piedras (F.S.).

Castor Bean

Corythucha gossypii Fab. was more or less abundant on nearly all plants observed in various parts of the Island thruout the year as is usual.

Casuarina equisetifolia Forat

This tree which is widely grown in Puerto Rico as an ornamental and as a wind-break for citrus had heretofore been considered as practically if not entirely immune from insect attack in the Island. Continued obseration has finally disclosed the following insect pests:

Icerya purchasi Mask., the cottony cushion—scale was first found in very small numbers in Santurce in October but during the late winter and spring and early summer it became generally distributed

and often injurious on ornamental casuarina trees and hedges thruout San Juan and Santurce south to at least Martín Peña and also infested wind-breaks in several citrus groves in Palo Seco, Bayamón and Dorado.

Icerya monserratensis R.& H.,another mealy bug which has been long known to infest *Ficus nitida* or West Indian Laurel (which see) in Puerto Rico was brought in on April 10 by Edumudo Martínez of the Insular Forest Service as moderately infesting all the casuarina trees in the Plaza at Cayey. He stated that there had been some rain there recently and that the insects were apparently somewhat less numerous than at a previous inspection about 3 weeks or a month ago.

Howardia biclavis Comstk. (Morrison det.) was found infesting a number of trees at the Scoville place on the Carolina road near Río Piedras (G.N.W.); it was also collected in moderate abundance on several small trees at the Forest Service Station at Río Piedras on Mar. 29 (M.D.L.)

Hemichionaspis minor strachani Cooley (Morrison det.) was also collected from one tree lightly infested at the Forest Service Station on Mar. 29 (M.D.L.).

Diaprepes spengleri L adults were observed in considerable numbers in copula and aparently feeding to a slight extent on a hedge near San Juan on May 7 (M.D.L.)

Cedro Hembra (*Turpinia paniculata* Vent.)

Hypsiphila grandella Zell., a lepidopterous shoot-borer (Heinrich det.), was reported on June 11 as injuring to a considerable extent about 4,000 trees planted among coffee for shade at Jayuya and on June 29, 1931, 1,000 young trees recently planted in a coffee finca at Adjuntas. In mid-July F. Seín Jr. reported that a number of young trees were moderately infested in the Rural School planting in Lares. This pest was also generally present and badly skeletonizing these shade trees in another large coffee finca (Hacienda Carmelita) in the general vicinity of Adjuntas in September.

Celery

A mealy-bug, presumably *Pseudococcus citri* Risso, was found on July 2 to be moderately infesting several plants (one badly infested) at the Station grounds in Río Piedras. The bugs were clustered at the base of the plants just above the ground and a few were on the roots. There is only one previous record for celery in Puerto Rico —collected by T. H. Jones, July 3, 1912, Río Piedras, Morrison det.

Chalcas exotica

Coccus viridis Green, the green scale, was observed on the leaves and twigs of one bush at Vega Baja on Dec. 29 (R.F.).

Chayote

Margaronia nitidalis Cr. 2 larvae in a crate on Feb. 26 for shipment to the States (C.G.A., Schaus det.).

Chick pea

Rhizopertha dominicana Fab., a Bostrychid beetle, was found infesting about 10 per cent of the peas in a small package in Santurce on Nov. 11 (R.G.O., W.S.Fisher det.).

Cephalonomyia gallicola Ashm., (Muesebeck det.) was lightly infesting a package the same package (R.G.O.). Not in Wolcott's "List".

Chocolate

Oryzaephilus surinamensis L., the saw-toothed grain beetle, was found, several adults, larvae and pupae, in the chocolate coating of candies from Switzerland via New York about a year previous (A. S.M., Fisher & Boving det.).

Laemophlaeus minutus Oliv. (Fisher det.). An adult on chocolate cake in a restaurant in San Juan, June (C.G.A.).

Chrysobalanus icaco L.

Nessorhinus vulpes A. & S. (Membracidae, P.W.Oman det.). A few adults on the stems of hicaco at Arecibo, May 20 (C.G.A.) Not in Wolcott's "List".

Citrus

Icerya purchasi Mask., the cottony cushion-scale, was first discovered in considerable abundance on a number of grapefruit trees in a large grove at Palo Seco on April 2. Continued search from then on to the end of June discovered infestation in grapefruit groves in Bayamón and Dorado, 6 in all, and on many ornamental citrus trees thruout San Juan and Santurce south to at least Martin Peña. In 3 or 4 of these groves the infestation developed rapidly to considerable proportions but it was largely checked by the end of the year by spraying, native natural enemies and the prompt introduction of the Australian or Vedalia ladybeetles. The most efficient and widespread parasite was a Phorid fly, *Syneura cocciphila* Coq.,

which was present in nearly every infestation found on all food-plants, often killing as high as 50 per cent of the insects in large individual colonies. Other natural enemies were the lace-wing fly, *Chrysopa collaris* Schneider, the common Coccinellid, *Cycloneda sanguinea* L. and often where well-established dense colonies were present the scavenger and scale-feeding caterpillar, *Ercuntis minuscula* Wlsm. Food-plants other than citrus were: Australian pine, *Casuarina equisetifolia;* rose; gallego, *Polsias guilfoylei;* gallito, *Agati grandiflora;* pigeon pea; María, *Callophyllum antillanum;* and Acalypha sp.

Asynapta citrinae Felt an Itonid cambium miner found in July in grapefruit twigs at Isabela; the pink maggots formed cocoons in the soil on July 11 and 2 adults emerged on July 15 (G.N.W.).

A snail, as yet undetermined, of small size, skeletonized the leaves in a seed-bed of several thousand grapefruits at the experimental plantings at Trujillo Alto the end of August; the seedlings were not more than 6 ins high and were generally infested, about 5 per cent being killed before control measures could be applied (E.H. Twight).

A mite, *Uropoda* sp. (H.E.Ewing det.) found infesting the skin of 1 out of 50 grapefruits examined at Mayagüez on Jan. 22 (A.G.H.).

Catyclysta miralis Möschler (Wm. Schaus det.) a Pyralid moth taken on a kumquat leaf at Río Piedras Mar. 15 (A.S.M.).

Lachnopus curvipes Fab., a weevil, was reported by Dr. Wolcott to be locally more abundant around Isabela during July than the common "vaquita", *Diaprepes spengleri,* which causes the bulk of the injury to citrus foliage. A small number of adults were found on grapefruit leaves at Barceloneta on May 10 and a few eating the leaves in a grove at Vega Alta on May 15 (C.G.A.).

Diaprepes spengleri L. and its varieties was about as abundant, with local variations, as usual thruout the citrus section, doing considerable damage to foliage and often causing very young fruits to drop by cutting them off at the stem attachment. In general the season of greatest abundance of adults was apparently April or May into June or July. Dr. Wolcott reported that in September adults were less abundant at Isabela and only 1 or 2 egg-clusters could be found after several hours search on a certain day, whereas many were found toward the end of August in the same place in a much shorter time.

Exopthalmodes roseipes Chev., the "vaquita verde" beetles were present during the spring and early summer as usual doing injury

to citrus foliage; they were observed as especially abundant in May in several grapefruit groves in Palo Seco, Manatí and Vega Alta.

Blossom thrips were common in various parts of the citrus section during a considerable blossoming period from April into May. Specimens were identified by J.R.Watson as *Frankliniella difficilis* Hood and *F. insularis* Fkln. The latter is the common black blossom thrips thruout the West Indes. *F. cubensis* Hood, a yellow species, was also apparently involved. It should be here noted that the writer overlooked in a note on citrus thrips in Puerto Rico (Jour. Econ. Ent. 25(4): 934–935, 1932) that Dozier had listed *F. tritici* Fitch as taken in grapefruit blossoms at Trujillo Alto (Jour. Dept. Agr. P. R. 10(3&4): 280, 1926, issued 1927).

Papilio androgeus Cr., the orange dog, was reared to adult on July 12 from a caterpillar found on grapefruit foliage sometime previous in Isabela; 2 other caterpillars brought in on the 12th (G.N.W.).

Corythucha gossypii Fab. was observed in several places from time to time infesting both grapefruit and lime and citron foliage but more abundant and actively breeding on the last especially at Palo Seco and Río Piedras.

Fecel ; minor Voll. (Pentatomidae, H.G.Barber det.) adults found in small numbers on the fruit in an orange grove near Ponce and in two groves near Peñuelas on Jan. 25 and on March 8 (R.G.O.). Adults were very prevalent during January and February in the Ponce district on wild oranges causing about an 8 per cent loss of fruit. Not in Wolcott's "List."

Dialeurodes citrifolii Morg., the cloudy winged whitefly, heavily infesting the leaves of two lime trees at Ponce on April 8 (R.G.O., Morrison det.).

Pseudococcus citri Risso, the citrus mealybug, was observed to be fairly common on the larger branches of grapefruit trees in several groves in the eastern part of the citrus section.

Piezosternum subulatum Thunb. (Pentatomidae, H.G.Barber det.). 1 adult on a grapefruit leaf at Bayamón on June 12 (C.G.A.).

Toxoptera aurantii Boyer was moderate to abundant on new growth during the spring in grapefruit in several sections, being especially noted at Arecibo, Bayamón and Manatí.

Aphis gossypii Glov., the melon aphid, heavily infested the tender shoots and leaves of many young grapefruit trees at Añasco on Jan. 27 (A.G.H., P.W.Mason det.). Apparently the first record of injury to citrus in Puerto Rico.

Aleurothrixus howardi Quaint. (G.B.Merrill det.) was observed in moderate numbers on grapefruit leaves on several trees in a large grove in Palo Seco during April and on one tree in a grove at Toa Baja in May (A.S.M., M.D.L.).

Eugnathodus guajanae DeL. (Cicadellidae, P.W.Oman det.) an adult on a grapefruit leaf at Bayamón, May 15 (C.G.A.).

Dikraneura (*Hyloidea*) *depressa* McAtee (Cicadellidae, P. W. Oman det.) in small numbers, adults, on several grapefruit trees at Arecibo, Apr. 5 (R.F.). Not in Wolcott's "List."

Empoasca minuenda Ball (Cicadellidae, P.W.Oman det.) present in small numbers as adults on grapefruit leaves in a grove at Arecibo on Apr. 5 (C.G.A.). Not in Wolcott's "List."

Ormenis infuscata Stål (Fulgoridae, P.W.Oman det.). Several adults on grapefruit leaves at Arecibo, Apr. 5 (C.G.S.).

Ormenis quadripunctata Fab. (Fulgoridae, P.W.Oman det.) a few adults on grapefruit leaves at Bayamón on Apr. 8 (A.S.M.).

Delphacodes sp. probably new (Fulgoridae, P.W.Oman det.)—an adult on a grapefruit leaf, Bayamón May 15 (C.G.A.).

Ecpantheria icasia Cram. (Arctiidae, Schaus det.)—an adult reared from a larva on a grapefruit leaf, Bayamón, May 15 (C.G.A.).

Edessa cornuta Burm. (Pentatomidae, H.G.Barber det.) in small numbers as adults on grapefruit leaves on several trees at Bayamón on Apr. 15 (C.G.A.).

Rhaptinus torquatus Oliv. (Curculionidae, L.L.Buchanan det.) in small numbers on grapefruit leaves at Las Marías, May 3 (C.G.A.).

Brentus volvulus Fab. (Brentidae, L.L.Buchanan det.) adults found on grapefruit blossoms at Mayagüez, May 17 (A.G.H.).

Chionaspis citri Comstock, was common to abundant on the trunks and larger branches of many grapefruit trees examined during April and May in groves at both Palo Seco and Bayamón; a considerable percentage of the male scales had parasite emergence holes.

Ceroplastes floridensis Comstock, the wax scale, was present in small numbers on a few grapefruit trees in a grove at Palo Seco and was also observed in one or two other places in the eastern part of the citrus section.

Anastrepha sp. the west Indian fruit-fly was found lightly infesting a few grapefruits in one grove near Mayagüez and in two groves near Arecibo in April.

Coconut

Aspidiotus destructor Sign., the coconut scale, was reported by F. Méndez, Coconut Specialist at the Station, as being not nearly so

abundant at Cabo Rojo in September as it had been 5 or 6 months previously. On Sept. 26, as far as could be observed practically every coconut palm on Vieques Island was more or less infested, those towards the eastern and drier end of the Island especially so, many palms having a sickly and yellow appearance and in some cases even the fruits were encrusted with the scales.

Coffee

Leucoptera coffeella Staint., the coffee leaf-miner, was generally distributed and quite abundant thru the whole of the Hacienda Carmelita, a large coffee farm in the vicinity of Jayuya, visited Sept. 9–10 but apparently not much damage was being done to bearing trees. According to Vicente Medina, Coffee Specialist at the Insular Experiment Station, the leafminer was more abundant during Dec. and Jan. than the two previous months due to generally dry weather thruout the coffee growing regions.

Coccus viridis Green, the green scale, was general tho not very abundant thruout the Hacienda Carmelita on the visit referred to above, the younger shoots and leaves being more infested than older parts, as is usual.

Psychonoctua personalis Grote, a Coffee stem-borer was received under date of Sept. 29 in injured branches from the Agr. Agent at Corozal with the statement that considerable damage was being done by the hollowed-out branches being broken off when they were bent down by the pickers.

Apate francisca Fab., a coffee stem-borer, was reported by Vicente Medina of the Station staff as damaging some trees on a farm at Adjuntas on April 18.

Psyllia minuticona Cwfd. present in small numbers as adults on coffee leaves at Adjuntas April 14 (R.G.O., P.W. Oman det.).

Bothriocera venosa Fowl. (Fulgoridae, P.W.Oman det.), in small numbers as adults on coffee leaves at Adjuntas, April 14 (R.G.O.).

Scymnillodes gilvifrons Chpn. (Nitidulidae, E.A.Chapin det.) on coffee leaves at the Torres finca at Adjuntas, April 14 (R.G.O.). Not in Wolcott's "List."

Psorolyma maxillosa Sic. (Coccinellidae, E.A.Chapin det.) in small numbers on the leaves out of 30 plants examined at Utuado on May 17 (R.G.O.).

Corn

Heliothis obsoleta Fab, the corn earworm, infested practically every ear of sweet corn at Isabela during September (G.N.W.); the

ears in 4 boxes of corn from Añasco examined Mar. 7 were heavily infested (A.G.H.).

Diabrotica graminea Baly was abundant and injurious to corn at Isabela during July (G.N.W.).

Disonycha laevigata Jacoby present in large numbers on corn leaf-sheaths at Loíza on April 11 (C.G.A.).

Peregrinus maidis Ashm. adults common on leaf-sheaths of several plants at Loíza Apr. 11 (C.G.A.).

Solubea pugnax Fab., (H.G.Barber det.) in small numbers as adults on corn leaves at Jayuya on May 14 (R.G.O.).

Orius (*Triphleps*) *insidiosus* Say (Anthocoridae, H.G.Barber det.) adults common on leaf-sheaths of several plants at Loíza, Apr. 14 (C.G.A.).

Laphygma frugiperda A. & S. moderately infesting corn ears at Loíza, Apr. 11 (C.G.A.).

Oscinella coxendix Fitch. (J.M.Aldrich det.) common on leaf-sheaths of several plants at Loíza, Apr. 11 (C.G.A.). This species is little-known in Puerto Rico.

COTTON

Pectinophora gossypiella Saund., the pink bollworm, was much less injurious to this past year's crop than to that of the previous year; the explanation for this is not clear. The clean-up, altho not carried out as thoroly as had been hoped for on the crop remnants from the previous season, might have been responsible for some reduction in the pink bollworm population. The acreage in cotton was greatly reduced, however, especially in the South Coast and theoretically there should have been a greater infestation. As an example of the reduced infestation it may be stated that as late as Jan. 20 J. Pastor Rodríguez, Cotton Specialist at the Station, reported a 1-acre field in the South Coast, which last year had been very badly infested, to show less than 1 per cent of the bolls infested and a nearby field only about 5 per cent. (For a more complete account of conditions covering the infestation of the previous crop thru picking into the fall of 1931 on the North Coast see Leonard in Jour. Dept. Agr. P. R. 16(1): 65–73, 1932).

Alabama argillacea Hübner, the cotton leaf-worm, was also much less numerous and injurious than during the previous crop; it was, in fact, practically negligible; two small outbreaks were reported from the South Coast during the latter part of December and the middle of January but these were easily controlled by two applications of poison. During July (on the previous crop) it was destruc-

tive thruout the whole North Coast but most injurious around Isabela and Camuy; during August the attacks naturally abated on the North coast due largely to the fact that most of the plants by that time were old and no longer succulent. According to F.E.Rorke of the San Juan Ginnery at least 80–85 per cent of the crop had been picked by the end of August in the North Coast but the leaf-worm continued active until at least the middle of the month around Manatí and apparently there was a certain amount of leaf-worm feeding in several other localities.

Dysdercus spp., mostly *D. andreae* L, the common cotton stainer, with occasionally undoubtedly a slight intermixture of *D. neglectus* Uhl. were more or less abundant on cotton bolls as usual, especially during the end of the crop, but altho they are responsible for some staining of the lint no attempt has been made to estimate how much damage is done.

Empoasca sp. leafhoppers were always to be found as usual in small to moderate numbers in all stages on the plants. Altho the Puerto Rican specimens have never as yet been specifically determined they probably belong to *E. gossypii* DeL described from Haiti in the April 1932 number of this Journal.

Nepticula gossypii Fbs. & Leon., the cotton leaf-miner, was present apparently in about the same numbers on the South Coast as during the previous year but as before was not observed to occur in the North Coast.

Ephestia cautella Wlk. (Pyralidae, Heinrich det.). A few adults observed on several tons of cotton seed cake at the Ginnery at Hato Rey on Mar. 9 (A.S.M.); an adult was also taken on a sword-bean leaf at Arecibo on Mar. 8 (C.G.A.).

CROTALARIA

Utethesia ornatrix L., the rattlebox moth, was reported as very abundant by Dr. Wolcott the middle of Oct., the caterpillars searching for food in great numbers on the beaches at Isabela; the moths were also common at lights at Isabela. This species was more or less injurious as usual to Crotalaria grown for seed thruout the Island.

Nezara viridula L. was present in large numbers, both as nymphs and adults, on the leaves and pods on the Preston farm at Naguabo on June 3 (C.G.A., H.G.Barber det.).

Nezara marginata P. de B. Many specimens clustered on a single pod at Isabela in July (G.N.W.).

Grape

Aphis illinoisensis Shimer, the black grape aphid, was present in small numbers on several vines in an arbor at Ponce early in March. It was also abundant on the tender shoots of a fairly large arbor at Puerto Real, Vieques Island, Sept. 8.

Grasses

Scapteriscus didactylus Scudder, the changa, did considerable damage to the St. Augustine grass in the fairways on the golf course at San Juan during dry weather in the spring of 1932.

Cicadella similis Walker (P.W.Oman det.) adults were very abundant on mallojillo or Para grass, *Panicum barbinode,* at Bayamón, May 15 (C.G.A.).

Collaris oleosa Dist. (Miridae, H.G.Barber det.) adults numerous on Para grass at Bayamón, May 15 (C.G.A.). Not in Wolcott's "List."

Zelus subimpressus Stal (H.G.Barber det.) adults numerous on Para grass at Bayamón, May 15 (C.G.A.). Not in Wolcott's "List."

Catorhintha guttula Fab (H.G.Barber det.) a small number of adults on grass at Ponce, June 8 (R.G.O.).

Mormidea cubrosa Dallas (H.G.Barber det.) present in moderate numbers on grass at Ponce, May 13 (R.G.O.). Not in Wolcott's "List."

Psara phaeopteralis Guen. was reported on July 8 as injurious to "gramma" grass (St. Augustine grass) at Isabela. The grass on a large lawn was worse affected in the shade than in the sun (G.N.W.).

Guava

Leptomastix dactylopii Howard (Encyrtidae, Muesebeck det.). A pupa found in a guava fruit infested with *Anastrepha* sp. larvae (C.G.H.). Not in Wolcott's "List."

Coccus viridis Green, the green scale, moderately infesting the leaves of two bushes at Arecibo, Feb. 23 (A.S.M.).

Lechriops psidii Marshall (Curculionidae, Buchanan & Boving det.) larvae in mummied fruits at the Atlas Fruit Co. in Bayamón, Jan. 11 (C.G.A.). Apparently the second record from P. R., the type being the first.

Ormenis infuscata Stal (P.W.Oman det.) one adult on a guava leaf at Arecibo, Jan. 26 (R.F.).

Xyleborus sacchari Hopk. (Blackman det.) reported as infesting 2 out of 10 fruits examined at Cabo Rojo, Sept. 16 (A.G.H.).

Leptoglossus stigma Hbst. (H.G.Barber det.) abundant on the leaves of 3 guava bushes at Cidra, Nov. 13 and many adults on a bush at Trujillo Alto, Oct. 23 (A.S.M.).

Argyria diplomachalis Dyar (Pyralidae, Schaus det.) adults common on several bushes at Corozal, Mar. 18 (C.G.A.).

Heterothrips sericatus Hood (J.R.Watson det.) numerous in all of the blossoms on one bush at Barceloneta, June 14 (A.S.M.)

Metachroma sp., new to U.S.N.M. (H.S.Barber det.) found in small numbers on the leaves at Río Piedras, May 31 (C.G.A.).

Pulvinaria psidii Mask. (Morrison det.) moderately infesting the leaves at Lares, April 15 (R.G.O.).

Anthonomus inovatus Dietz (Buchanan det.) one adult on a fruit at Adjuntas, Apr. 11 (R.G.O.). Not in Wolcott's "List.".

Aleurodicus (*Metaleurodicus*) *minimus* Quaintance (G.B.Merrill det.) moderately infesting the leaves of 2 guava trees on the Denton Farm at Arecibo, Feb. 23 (C.G.A.).

Ormenis pygmaea Fab. (P.W.Oman det.). Adults in small numbers on the above trees (A.S.M.) and a moderate number of adults on a coffee tree at Arecibo on Mar. 8 (C.G.A.).

Hibiscus

Frankliniella cubensis Hood and *insularis* Franklin (J.R.Watson det.) adults in flowers at Mayagüez, March 20 (A.G.H.).

Haplothrips n. sp. (Watson det.) adults in flowers at Mayagüez, Mar. 20, (A.G.H.)

Inga Spp.

Tanaostigmodes portoricensis Cwfd. (Muesebeck det.) Heavily infesting pods of Guamá, *Inga laurina,* at Mayagüez, March 24. (A.G.H.) Previously known in P. R. only from the type.

Brenthia pavonacella Clem. A leaf-skeletonizer, badly infested the Inga shade trees thruout the coffee growing regions from fall to spring.

Carpolonchaea pendula Bezzi (Aldrich det.) adults reared from *Inga laurina* fruits, 25 per cent infested, at Jayuya, Jan. 18 (R.G.O.)

Jobo (*Spondias dulcis* Frost)

Haptoncus luteolus Er. and *Urophorus humeralis* Fab. (E.A. Chapin det.). All the fruits in a small package infested at Arecibo, Oct. 29 (R.G.O.). The latter not in Wolcott's "List."

Mahogany

Saissetia oleae Bern. and *Chrysomphalus dictyospermi* Morg. (Morrison det.) Very bad on a number of young trees at Forestry Station, Río Piedras, Mar. 29.

Malay Apple (*Jambos malaccensis*)

Coccus mangiferae Green, *C. acuminatus* Sign. and *Diaspis boisduvalii* Sign. (Morrison det.). Moderately infesting the leaves of two trees near Río Piedras, Jan. 11. (A.S.M.) The last not in Wolcott's "List."

Eucalymnatus tessellatus Sign. (G.B.Merrill det.). Same as above.

Mamey (*Mammea americana* L.)

Toxoptera aurantiae Boyer (P.W.Mason det.) Young leaves heavily infested on small trees at Las Marías, Mar. 17 (A.G.H.)

Patara albidula Westw. (P.W.Oman det.). Adults common on one tree at Barceloneta, Mar. 22 (C.G A.). Not. in Wolcott's "List."

Mango

Selenothrips rubrocinctus Giard did considerable damage to the foliage of 1,000 nursery trees at the Station in August.

Asterolecanium pustulans Ckll badly infested 3 trees at Río Piedras, Feb. 23.

Mangrove

Psychonoctua personalis Grote badly infested a large area of mangrove swamp at Pt. Cangrejos near San Juan in April. The trunks and branches down to ground level were badly tunneled in nearly all the plants. Larvae of all sizes, pupae, and empty pupal skins were present. It was cut before maturity, causing a considerable loss in the yield of charcoal.

María (*Calophyllum antillarum* Britt.)

Eucalymnatus tessellatus Sign. (Morrison det.) lightly infested one tree near Río Piedras, Feb. 17 (C.G.A.)

Pseudococcus adonidum L. (Morrison det.) heavily infested the leaves of a tree near Río Piedras, Feb. 17. Not in Wolcott's "List."

Oxacis sp. probably new (H.S.Barber det.) Adults numerous on the leaves of several trees in Santurce, May (A.S.M.)

Toxoptera aurantiae Boyer and *Aspidiotus cocotiphagus* Marl. lightly infesting the young shoots on several trees in Santurce in May. First record for this host in P. R.

Icerya purchasi Mask. was abundant during the spring and early summer on a number of trees in Santurce.

OKRA

Pectinophora gossypiella Saund. was found on July 10 infesting 10 out of 16 pods examined in a 1-acre planting at Trujillo Alto. The okra adjoined a field of about 1½ acres of cotton which showed about 85 per cent infested bolls. The okra plants examined were situated near the edge of the field next to the cotton. The infested pods were all mature, at least 3 or 4 inches in length, and each contained 1 or 2 larvae and several pupae were found within the pods. The cotton was an old field which had been infested for some time. In July (A.S.M.) okra planted experimentally at Isabela with cotton was also infested.

Diabrotica gramina Baly did considerable damage at the Station during August and moderate damage in a 1-acre planting in Trujillo Alto in July.

Aphis gossypii Glover was generally present but not very injurious at the Station during July.

Corythucha gossypii Fab. was found towards the end of the month in small numbers on the okra at the Station. The okra adjoins the pole limas on which the insects were breeding very abundantly. Only adults could be found but these were feeding to a noticeable extent, causing the characteristic yellowish stippled areas on the leaves.

Hyaliodes n. sp. (H.H.Knight det.) was present in some numbers in the same planting.

OLEANDER

Asterolecanium pustulans Ckll., was very abundant on a number of oleanders at Guánica on March 12. A plant was also heavily infested at Old Loíza, April 29 (A.S.M.).

PALM

Pinnaspis buxi Bouché, heavily infesting a palm at Pennock's nursery near Río Piedras, Feb. 17 (R.F.; Morrison det.). Not in Wolcott's "List."

Eucalymnatus tesselatus Sign. (Morrison det.) heavily infested a palm in a nursery near Río Piedras, Feb. 17 (C.G.A.)

Pseudococcus nipae Mask. moderately infested a palm in Santurce, May 23.

PANAMA POTATO TREE

(*Solanum grandiflorum leiocarpum*)

Pseudococcus citri Risso (Morrison det.) lightly infested the leaves of 6 large trees at the Station at Río Piedras, Feb.; also 30 trees near Juncos, Jan. 25 (C. G. A.)

Pseudoparlatoria ostreata Ckll. A heavy infestation on the bark on one of the trees at Juncos.

PAPAYA

Toxotrypana curvicauda Gerst. Three medium sized fruits sent in by the Agricultural Agent at Jayuya with letter of June 1 stating that they came from a planting of about 50 trees just coming into production on the farm of Dr. Manuel Megías, Barrio Collores. All were fairly green, the 2 smaller moderate sized ones had been badly infested but the larger one was clean—only 1 or 2 dead larvae present. The papaya fruit fly was also sent in under date of July 8 by F. B. McClelland from the Mayagüez Experiment Station in a rather small and rather green fruit which contained 14 newly formed puparia and 1 full grown larvae (M. D. L.) One fruit was found infested at the substation at Isabela on July 3 and sometime during the month all of the fruit on several plants in a farm near Aguadilla were infested (G. N. W.) It was also found to be infesting the fruit of a number of plants on a farm near Ponce on Aug. 5. One fruit small and green and about 2½ inches long contained 20 larvae and another somewhat more mature and about 5 or 6 in. long contained 24 larvae; in both fruits the maggots were nearly to full-grown. The owner, Mr. Heraclio Girón, stated that during May and June nearly all of the fruits on his trees were infested, many so badly that they had to be thrown away. It was not found in several fruits cut open at the farm of Heraclio Girón near Ponce on Sept. 9. Mr. Girón stated that no infested fruits had been noticed for several weeks whereas formerly they had been heavily infested. As previously reported many infested fruits had been destroyed and I suspect that this resulted in greatly reducing the infestation in his planting.

Pseudoparlatoria ostreata Ckll. Heavily infested the fruits and stems of a papaya in San Juan, Jan. 13 (A. S. M.) It was abundant also on a number of trees in the Girón farm near Ponce, September.

Aulacaspis pentagona Targ. moderately infested the trees on the Girón farm. There was also a heavy infestation at the Isabela Substation in March.

Saissetia hemisphaerica Targ. also heavily infested the trees at Isabela.

Corythucha gossypii Fab. heavily infested the trees at Isabela during March and as is usual was observed in other places thruout the season.

Epitomiptera orneadalis Guer. (Schaus det.) A larva was found feeding on a papaya leaf, Mar. 8 (C. G. A.) Not in Wolcott's "List."

Nezara viridula L. (H. G. Barber det.). A light infestation of nymphs on papaya leaves near Río Piedras, Mar. 9 (C. G. A.).

PEAS

Illinoia solanifolia Ashm (P. W. Mason det.). One winged adult was on a pea leaf at Cidra, Feb. 26 (A. S. M.) Not in Wolcott's "List."

Piezosternum subulatum Thumb. (H.G.Barber det) a small number of adults on garden pea leaves in a small patch on the Vivell farm at Trujillo Alto, Feb. 5 (A.S.Mills).

Agromyza pusilla Mg. adults reared from larvae making serpentine mines in pea leaves—a moderate infestation in a 2-acre planting at Cidra, Feb. 26 (A.S.M.; J. M Aldrich det.). In Wolcott's "List" but without definite food-plant or locality.

PEPPER

Aleurotrachelus trachoides Back (M. D. L. det.) moderately infested a number of plants at the Station at Río Piedras October and was noticed in April. It was also found August 17 to be badly infesting a house plant in Santurce.

Coreocoris batatas Fab. a light infestation on the leaves of a 5 acre pepper field at Vega Alta on Dec. 29 (A. S. M.; H. G. Barber det.)

Myzus persicae Sulz., was found to be lightly infesting the leaves of a 5 acre pepper field at Río Piedras on Feb. 8 (R. F.; P. W. Mason det.).

Disonycha laevigata Jacoby (H. S. Barber det.) lightly infesting the foliage and fruit of peppers and a moderate infestation on cucumber at Loíza on Feb. 7. There were 5 acres of peppers and 1 acre of cucumbers. (A. S. M.)

Chrysocharis parksi Cwfd. adults reared from pupae of *Agromyza pusilla* Mg. mining in pea leaves at Cidra, Feb. 26. 30 per cent of the dipterous pupae parasitized with this or another species. Not in Wolcott's "List."

Saissetia hemisphaerica Targ. (Morrison det.) lightly infesting the stems of 3 plants at the Experimental Farm at Trujillo Alto, Mar. 9 (C. G. A.).

Pigeon Pea

Etiella zinckenella Tr. (Heinrich det.) larvae were found in hampers of pigeon peas from Aguadilla, Lajas and Isabela for shipment to the States (A. G. Harley).

Heliothis virescens Fab. (Heinrich det.) larvae lightly infested hampers of pigeon peas to be shipped to the States from Lajas in March, Aguas Buenas and San Sebastián in January and from Aguadilla and Isabela (A. G. H.)

Icerya purchasi Mask. was found from April on, lightly to moderately infesting pigeon peas grown near infested citrus in Palo Seco and Bayamón.

Saissetia oleae Bern. (Morrison det.) so badly infested 4 bushes at Lajas on Feb. 13 that they were nearly dead (A. G. H.)

PINEAPPLE

Phyllophaga spp. larvae were reported on Apr. 13 by Eugenio Rivera, Agr. Agt. at Manatí, as having badly injured a number of pineapple fields at Vega Baja and Corozal during November and December.

Solenopsis geminatum Fab. also did considerable damage in the same place.

Cutworms (Noctuidae). J. E. Raymer reported (specimens submitted) on Feb. 15 that cutworms had been at that time working for about 3 weeks on 10 acres of his pineapples at Arecibo, causing a loss of about ⅓ of the plants by eating out large holes and destroying any market value of these plants.

Pomarrosa (*Jambos Jambos* L.)

Coccus acuminatus Sign. (Morrison det.) infesting many leaves of a pomarrosa tree at Corozal Feb. 9 (C. G. A.).

Saissetia oleae Bern. (Morrison det.) Infested many leaves of one tree at Corozal, Feb. 9 (A. S. M.)

Colpoptera maculifrons Muir (P. W. Oman det.) adults numerous on the leaves and stems at Bayamón, June 6 (A. S. M.)

Ormenis pygmaea Fab. (P. W. Oman det.) Many adults on the leaves of several trees at Corozal, Apr. 12. (C. G. A.)

Philaenus fuscovarius Stal. one adult on a pomarrosa twig at Bayamón, June 6 (C. G. A.)

Potato, Irish

Xylomyges eridania Cr. (Schaus det.) larvae were found to be eating many of the leaves in a 25 acre field of Irish potatoes on the Ellsworth farm at Cidra, Feb. 5 and a light infestation of the larvae was found on foliage on a 5-acre field of peppers on the Cabrera farm at Loíza on Feb. 8 (A. S. M.)

Cutworms (*Noctuidae*) had destroyed about 5 per cent of one-month old Irish potato plants on ½ acre at Aibonito by Feb. 3 altho many of the injured plants were sending up new shoots; Severo Pagán, Agr. Agt. at Aibonito reported that 4 or 5 plantings in the vicinity were similarly affected (F. Chardón).

Diabrotica graminea Baly, was reported on Feb 2 as doing considerable damage to both snap beans and Irish potatoes at Orocovis.

Aleurotrachelus trachoides Buck, badly infested a number of experimental Irish potato plants in the station greenhouses during April.

Nezara viridula L. (H. G. Barber det.). A small number of adults on the leaves of a 25-acre planting of potatoes on the Ellsworth farm at Cidra on Feb. 5 (A. S. M.).

Epitrix cucumeris Harr., the potato flea-beetle, was observed in moderate numbers in several places but not sufficient observations were not made to determine how much damage was done to the various plantings thruout the growing season.

Potato, Sweet

Agromyza ipomeae Frost was present thruout the year as usual in moderate numbers in all patches observed.

Euscepes batatae Waterhouse, was found lightly infesting one tuber in the public market at Puerta de Tierra, San Juan (R. F. & R. G. O.) Specimen sent in for determination on Apr. 6 by F. A. Velasco, Agr. Agent at Guayanilla, as badly infesting a small piece of sweet potatoes.

Spartocera batatae Fab. was abundant in all stages on a small patch of sweet potatoes in Hato Rey the end of April (F. Chardon). It was also reported as fairly abundant in all stages on several plants in Carolina on Nov. 2.

Cylas formicarius Fab. adults were not uncommon during 3 nights of collecting at light at Puerto Real, Vieques Island Sept 25–27. Arturo Riollano, the local Agricultural Agent, stated that he had observed the insect as generally distributed and very injurious since he had been on the Island from Sept. 1930. It was generally distributed and as injurious as usual in P. R. thruout the year.

Cyrtocapsus caligineus Stal (Miridae, H. G. Barber det.) was found abundant on March 16 on a small patch of sweet potatoes in the Governor's garden in Río Piedras (C. G. A.). Not in Wolcott's "List".

Bemisia inconspicua. What is undoubtedly this whitefly was received from Miguel Díaz, Agr. Agt. at Arecibo under date of Mar. 26 on sweet potato leaves for identification.

Pumpkin

Margaronia hyalinata L. (Schaus det.) was feeding on pumpkin leaves in a small garden at Juncos on Jan. 25 (R. F.).

Rose

Icerga purchasi Mask., the cottony cushion scale, was found moderately infesting a number of large rose-bushes in a home garden in Santurce where Mr. Luciano of the Insular Plant Quarantine Office said it had been present for at least two years; this was the first record for the Island.

Metachroma antennalis Weise, a leaf-beetle, was received under date of Sept. 4 for determination from the Aguirre Sugar Co. The beetles were said to be present in enormous numbers and doing great damage to rose bushes. Out of over 1000 good sized rose bushes over 400 had been killed, the beetles first eating the flowers, next the leaves and finally gnawing off the bark of the woody parts. The beetles first appeared in the spring of 1929 and were present the following year and this, from April into September. It was stated that when disturbed the beetles drop readily. This species was originally described from Puerto Rico in 1885 by J. Weise in "Beitrag zur Chrysomeliden und Coccinelliden Fauna von Puerto Rico" Archiv. fur Naturgeshichte 51(1):155 and has apparently not been reported outside of the Island. Here it has been reported as rather badly attacking cotton at Quebradillas in June 1922 and was found between leaves and in spider nests on various plants on the beach at Arecibo in May 1923.

Cryptocephalus nigrocinctus Suff. was reported as lightly infesting about 200 rose bushes on the farm of Pedro Osuna in the Barrio of Quebrada Arenas near Río Piedras. The beetles eat the leaves but especially the buds.

Conotelus fuscipennis Er. (E. A. Chapin det.). A moderate number of the beetles on the flowers of 3 bushes at Adjuntas, June 19 (R. G. O.).

Frankliniella insularis Franklin (J. R. Watson det.) reported on June 1 by the local Agr. Agt. in Vieques Id. as doing great damage in 5 different farms and trouble is apparently general; it was the first the growers have noticed trouble in Vieques but stated that it had been previously noted in Mayagüez and other towns but was never reported. Buds attacked never open and flowers are totally spoiled, withered ones being full of thrips when opened especially at base of petals. Some gardens were 100 per cent infested and not a sound rose could be picked. Canna blooms were also attacked but not much damage done.

Silk Oak (*Grevillea robusta* Cunn.)

Asterolecanium pustulans Ckll., was found infesting badly a fair-sized silk oak near Bayamón on Apr. 10; a number of twigs and smaller branches had been killed by the attack.

Spider Lily (*Hymenocallis declinata*)

Xanthopastis timais Cramer (Heinrich det.). From Oct. thru Jan. the larvae were very abundant and doing considerable damage to the leaves on about 10 ornamental plants in a large nursery near Río Piedras on Oct. 10 (M. D. L. & A. S. M.)

Squash (See cucumber and melon)

Sugar Cane

Diatraea saccharalis Fab. was reported in Sept. by I. Flores Lugo, Agr. Agt. of Carolina as causing a large percentage of "dead hearts" on about 4 acres out of about 200 acres of cane in the barrio Cangrejos Arriba of Carolina. The cane had been planted in April or May; this worse affected part had to be plowed up and replanted. The insect was not very abundant on Vieques Island during an inspection trip on March 23 due probably to the unduly high rainfall for the Island (72 ins.) of last year. (M. D. L.) The moth-borer however was worse according to S. C. McCall on the 1931 crop in

Vieques Island than on the 2 previous years' crops under his observation (a total of about 3,500 acres). He stated that Japanese cane, usually supposed to be somewhat less infested than other varieties was however the worst infested of all during this past year.

Pseudococcus boninsis Mask. (= *calceolariae* of authors) was not uncommon on sugar cane in several localities examined in company with C. E. Pemberton on Vieques Island on March 23. (M. D. L.; Pemberton det.)

Pseudococcus sacchari Ckll. was moderately common on both Uba and Crystalina (a little more so on latter apparently) in several sections examined on Vieques Island on an inspection trip on March 23. (M. D. L.)

Aspidiotus sacchari Ckll. was moderately common on a large lot of Uba cane being loaded at the dock on Vieques Island, examined on March 23. (M. D. L.)

Dyscinetus barbatus Fab. adults of a species known to injure cane were absent at lights at Isabela during the whole of July but began appearing again at lights on Sept. 2 at Isabela (G.N.W.)

Ligyrus tumulosus Burm. were abundant at light during July at Isabela and many were being eaten by the imported toad, *Bufo marinus* L. (G. N. W.) An adult was taken at a light in Santurce, Mar. 27 (A. S. M.; E. A. Chapin det.)

Phyllophaga vandinei Smyth. Scattering male adults were collected on Aug. 11 and 12 at Isabela but by the end of the month they were even yet not common there (G. N. W.)

Strataegus quadrifoveatus P. de B. Two adults of the coconut rhinoceros beetle were received under date of July 16 from Alberto Correa from Utuado with the statement that they were found eating the shoots of young cane plants; the injury was noted in several places near Utuado (M. D. L & F. S.).

Dyscinetus barbatus Fab. Adults of this Scarabeid beetle, an occasional minor enemy of cane were observed in small numbers at lights at Hato Rey on Aug. 31 (M. D. L.). At Isabela adults were not observed at lights thruout August and had not been seen at lights since June 8 (G. N. W.)

Remigia (Mocis) repanda Fab., the sugar cane looper, defoliated a small area of Para or malojillo grass (*Panicum barbinode*), young plant cane and half grown elephant grass (*Panicetum glaucum*) during July at Isabela (G. N. W.)

Sipha flava Forbes, the yellow cane aphis, was observed doing considerable damage in a number of large plantings of young to fairly large cane near both Aguirre and Santa Isabel on Aug. 22. Mr. Foss,

Ass't. Field Manager of the Aguirre Sugar Co. stated on that date that during all of July and Aug. there had been a rather general tho fairly light infestation thruout nearly all of the Company's extensive plantings—this in spite of the fact that the rainfall had been greatly in excess of normal. The insect was present to some extent on Vieques Island on Sept. 27 but S. C. McCall, local Mgr. of the United Porto Rican Sugar Co. on Vieques said it had been absent during the past year as far as he could observe. Its absence or at least scarcity was probably due to much more than normal rainfall on that Island. It was reported on Oct. 7 by Dr. T. Bregger of the Ins. Exp. Station to be fairly abundant on about 2 acres of 3 or 4 months' cane (old ratoons of POJ 2878) on the Station grounds; this in spite of recent abundant rains. He also reported on Oct. 1 that a field of Uba cane, ratooned 4 or 5 months previously, was conspicuously yellow from the road at Jayuya despite much recent rain there also. Under date of Oct. 22, a grower, Enrique López Delgado, wrote that especially in the barrio Miradoro of Cabo Rojo the yellow aphis had by then destroyed almost 25 per cent of the plantings and of the remainder about 50 per cent were infested. He reported the infestation as extending into the other cane growing section of Sabana Grande, San Germán, Lajas, Hormigueros and Mayagüez. In Miradoro not only Japanese cane was attacked but also BH 10(12) and POJ 2878. At the Station a 2 acre planting of 2 months' old ratoons POJ 2878 was lightly infested early in June despite 13 ins. rainfall during the previous month and another planting of the same size and variety was considerably infested thruout all of Feb., Mar. and Apr. with only 6 ins. rainfall for the 3 months.

Tamarind

Sitophilus linearis Hbst., the tamarind pod-borer, adults and larvae, found feeding in one pod in a crate of tamarinds for shipment to the States, Feb. 25 (C. G. A.; Buchanan det.).

Myelois ceratoniae Zell. (Heinrich det.) 20 per cent of about 100 pods examined at Trujillo Alto found infested with larvae; adults were reared (A. S. M.) Not in Wolcott's "List".

Tamarix sp.

Saissetia hemispherica Targ. (Morrison det.) fairly abundant on a couple of small trees of Tamarix sp. at the Forestry Station at Río Piedras on Mar. 29 (M. D. L.)

TOBACCO

Practically no definite observations were made on tobacco insects during the year but reports would indicate that the more important insects were present in about the usual numbers. Flea beetles were bad on experimental plantings at the Station during the dry spell thruout Feb. Mar. and April.

TOMATO

Scapteriscus didactylus Latr., was doing considerable damage to young tomato plants in a 3-acre field of tomatoes and to a 3-acre planting of eggplants on Nov. 6 at Loíza; grass land adjoined these fields (A. S. M.).

Myzus persicae Sulz. (P. W. Mason det.) was observed very lightly infesting the foliage of a 3-acre field of tomatoes at Loíza on Nov. 6 (A. S. Mills).

Cyrtopeltis varians Dist. (H. G. Barber det., Miridae) was found lightly infesting the foliage of a 3-acre field of tomatoes at Loíza on Nov. 6 (A. S. M.). Not in Wolcott's "List".

Agallia albidula Uhl. (P. W. Oman det.) lightly infested the leaves of tomatoes at Loíza, Nov. 6 (A. S. M.).

Grasshoppers (*Locustidae*) did considerable injury to several large tomato plants grown for experimental purposes in the greenhouse at the Station during the latter of September. The injury was by the young green nymphs.

Xylomyges eridania Cr. (Schaus det.) larvae moderately infesting tomato fruits, which were being eaten out at the Vivell farm at Río Piedras, Feb. 15 (R. F.)

Atherigona excisa Thom., many larvae in a decayed tomato from Isabela on Jan. 19 (C. C. A.; C. T. Greene).

Empoasca fabalis DeL., moderately infested a 3-acre field of tomatoes on Nov. 6 at Loíza (A. S. M.; P. W. Oman det.).

Flea beetles were bad on tomatoes at the Station in Río Piedras during the dry spell thru Feb., Mar. & Apr.

Epitrix cucumeris Harr. (H. S. Barber det.) was reported in large numbers on a number of plants on a farm at Adjuntas in March (R. G. O.)

Chaetocnema apricaria Suffr. (H. S. Barber det.) in moderate numbers on tomato plants at Jayuya on June 14 (R. G. O.)

TREE FERN

Pseudococcus adonidum L. (Morrison det.) found badly infesting the young fronds of two plants at Mayagüez, Mar. 18 (A.G.H.)

TROPICAL ALMOND (*Terminalia catappa* L.)

Ormenis marginata Brunn. (P. W. Oman det.) 3 adults resting on the leaves of one tree examined on Mar. 15 at Río Piedras (A. S. M.) and a small number of adults on the leaves of one coffee bush at the Demonstration Farm at Arecibo on Mar. 8 (C. G. A.)

Megalopyge krugii Dewitz, the puss-moth, was abundant on a number of trees on Apr. 21 near Arecibo (F. S.)

Monobelus fasciatus Fab. Membracidae—a small number of adults on the flower-stalks of several trees at Bayamón on March 21 (R. F.; P. W. Oman det.)

Attelabus sexmaculatus Chev. (L.L.Buchanan det.) One adult on a flower-stalk in examining several "almendro" trees at Bayamón on Mar. 21 (C. G. A.)

Urophorus humeralis Fab. and *Stelidota geminata* Say (Nitudilae, E. A. Chapin det.) feeding in the fruits at Arecibo, Oct. 10 (R. G. O.) and at Añasco, Sept. 29 (A.G.H.) respectively.

Haplothrips gowdeyi Fkln. (J. R. Watson det.) in small numbers on the leaves at Santurce, June 11 (A. S. M.). Apparently the first record for P. R.

Cicadella sirena Stal. (P. W. Oman det.) adults numerous on leaves, Arecibo, May 20 (C. G. A.).

Chalepus sanguinicollis L. (H. S. Barber det.) a small number of adults at base of flower-stalks, Arecibo, May 24 (A. S. M.).

VANILLA

Apodrusus wolcotti Marshall (Curculionidae, L. L. Buchanan det.) A light infestation of adults on flowers and stems found while examining 40 plants at Adjuntas, May 17 (R. G. O.)

VITEX ALTISSIMA

Saissetia oleae Bern. was fairly abundant on a single small tree at the Forest Service Station at Río Piedras on Mar. 28 (M. D. L.)

WATERLILY

Pentalonia nigronervosa Coq., a waterlily aphid, was reported by Dr. N. L. Britton as considerably infesting several plants at San Ger-

mán on Dec. 29 and in March he submitted specimens from the same place (F. Seín det.) In February F. Seín reported several plants killed at Santurce, the leaves being badly infested and curled.

West Indian Laurel (*Ficus nitida* Thumb.)

Gynaikothrips uzeli Zimm. was more or less abundant as usual on nearly all trees examined in various places.

Ischnaspis longirostris Sign. (Morrison det.) was found heavily infesting the leaves of several large trees on the Plaza in Caguas during April.

Ceroplastes floridensis Comstk. (Morrison det.). A light infestation on the leaves of the same trees.

Macrotracheliella laevis Champ. (Anthocoridae, H. G. Barber det.) found feeding in moderate numbers on the thrips mentioned above. Not in Wolcott's "List."

Icerya montserratensis R. & H. common on several of the trees in the Plaza at Caguas but they did not seem to be quite as abundant as last year; this may have been because the observations, such as were made, were during the periods of greater rainfall.

Cattle

Haematobia irritans L. the horn-fly, was observed to be very abundant on all the oxen on the Island of Vieques during a short trip there in September. S. C. McCall, manager of the local Sugar Co. stated that it had been worse this year than usual. One bull was covered with flies and in a greatly weakened condition. It was reported later that this one and several others had died from the effects of the bites. The considerably greater rainfall during some months past could have hardly been responsible for the great increase in numbers of this pest for in Puerto Rico proper it is ordinarily worse on the South Coast where the rainfall is much less than on the North Coast.

For several additional external parasites of animals see the Report of the Veterinarian in Rept. P. R. Agr. Exp. Sta. for 1931

Man

Culex nigripalpus Theo. (Alan Stone det.) adults collected at light in hotel room in Mayagüez on May 1 (C. G. A.).

Chrysops variegatus Deg. was occasionally annoying at Río Piedras and one or two other localities.

Miscellaneous Records

The following species have presumably not heretofore been recorded from Puerto Rico:

Argyria lacteella Fab. (Pyralidae, Schaus det.) An adult caught at light, Bayamón, Apr. 17 (C. G. A) and another on a lima bean leaf in a field at Loíza, Feb. 7 (A. S. M.).

Psara detritalis Guen. (Pyralidae, Schausdet.). An adult taken on a fruit in a hamper of peppers from Humacao, Feb. 4 (C. G. A.).

Mocis disseverans Wlk. (Noctuidae, Schaus det.). Adults taken at light at Bayamón, Apr. 17 and May 15 (C. G. A.).

Monodes agrotina Guen. (Noctuidae, Schaus det.) at light Bayamón, May 15 (C. G. A.)

Brachymeria ovata Say (Chalcididae, Musebeck det.). An adult reared from a lepidopterous pupa at Mayagüez, June 24 (A. G. H.). It is interesting to note that this species has been recorded from New York State where it has been reared from *Vanessa antiopa* (Cornell Univ. Agr. Exp. Sta. Mem. 101, 1928).

Nasutitermes costalis Holmg. (T. E. Snyder det.) collected at light at Bayamón, June 12 (C. G. A.).

Microbracon hebetor Say (Braconidae, Musebeck det.) in a package of pigeon peas being sent to the States from Ponce, May 18 (R. G. O.)

Chlorion (Ammobia) singularis Smith (Larridae, G. A. Sandhouse det.) collected in the automobile at Guánica No. 13 (A. S. M.).

Colyostichus biannulatus Mayr. (Callimomidae, Musebeck det.) Moderately infesting the fruits of Piper sp. at Cidra, Nov. 13, (R. G. O.).

Calliephialtes n. sp. (Ichneumonidae, R. A. Cushman det.) An adult on a grapefruit leaf at Añasco, May 2 (C. G. A).

Ceratomegilla innotata Muls. (Coccinellidae, E. A. Chapin det.) on a pepper leaf at Vega Alta, Nov. 24 (A. S. M.).

Monanus concinnulus Wlk. (Cucujidae, W. S. Fisher det.) on a window in a dining room, San Juan, Apr. 24 (C. G. A.).

Disonycha spilotrachelus Blake (Chrysomelidae, H. S. Barber det.) adults on an unknown weed, Santurce, June 29 (C.G.A.).

Stephanoderes braziliensis Hopk. (Scolytidae, Blackman det.) 1 adult in a decayed flower-stalk of banana, Bayamón, May 15, (C. G. A.)

Gnathocerus cornutus Fab. (Tenebrionidae, E. A. Chapin det.) An adult on a leaf of watercress in a dining room in San Juan, Feb. 21 (C. G. A).

Cylindera flava Fab. (Cerambycidae, W. S. Fisher det.). An adult on a lima bean blossom, Loíza, Dec. 1 (A.S.M.).

Sapromyza picticormis Coq. (Sapromyzidae, Aldrich det.) adults common on grapefruit at Arecibo, Mar. 1 (R. F.).

Sapromyza slossonae Coq. (Aldrich det.) resting on orange fruit at Pueblo Viejo, Feb. 13 (C. G. A.)

Conoderus bifoveatus Beauv. (Elateridae, W. S. Fisher let.) 2 adults on a flower-bud of *Terminalia catappa* at Barceloneta, May 10 (A. S. M.)

Sitodrepa panacea L. (W. S. Fisher) collected at light in a hotel room, Mayagüez, May 1 (C. G. A.)

Cactylosternum abdominale Fab. (Hydrophilidae, L. L. Buchanan det.). 1 adult at hotel light Mayagüez, May 1 (C.G.A.).

Siphunculina signata Wollaston (Chloropidae, Aldrich det.). An adult on a dining room window in San Juan, Apr. 1 (C.G.A.)

Leucomelina n. sp. (Anthomyidae, Aldrich det.). One adult on trail up El Yunque Mountain, near Luquillo, Mar. 13 (A.S.M.).

Ceropsilopa n. sp. (Ephydridae, Aldrich det.). Adults on under side of grapefruit leaves at Arecibo, Apr. 5 (C.G.A.).

Lasiochilus fusculus Reut. (Anthocoridae, H.G.Barber det.) adults on a decayed flower-stalk of banana at Bayamón, May 15 (C.G.A.).

Exitianus obscurinervis Stal. (Cicadellidae, P.W.Oman det.) 3 adults on leaves of an unidentified weed at Arecibo, June 7 (C.G.A.).

Megoura n. sp. (Aphididae, P.W.Mason det.). A moderate infestation on 5 plants (plant unrecorded) examined in Santurce, June 20 (A.S.M.).

Pycnoderes heidemanni Reut. and *Polymerus cuneatus* Dist. (H.G. Barber det.) collected by sweeping weeds in Santurce, June 29 (C.G.A.).

Coreocoris batatas Fab. (Coreidae) and *Engytatus geniculatus* Reut. (Miridae, H.G.Barber det.) 1 adult each at Añasco, May 2 (C.G.A.).

Oncopeltus fasciatus Dall. (Lygaeidae, H.G.Barber det.). 1 adult on a flower at Arecibo, Apr. 22 (C.G.A.).

Anasa scorbutica Fab. (H.G. Barber det.) a squash bug, was observed lightly infesting a 2-acre planting of squash at Vega Alta, Nov. 24 (A.S.M.).

The following records, altho not entirely new to Puerto Rico, are those of insects known heretofore only from the type material from Puerto Rico or for the most part from only one or two previous records:

Xestocephalus maculatus Osb. (Cicadellidae, P.W.Oman det.) collected at light in a hotel in Mayagüez (C.G.A.). Known only from types taken on Inga sp. on the Cayey road at about 2,000 ft. elevation.

Cicadella coffeeaphila Dozier (P.W.Oman det.). Several adults on an unidentified plant on the trail up El Yunque Mountain (A.S.M.).

Agallia pepino DeL. & Wolc. (Cicadellidae, P. W. Oman det.) collected at light in Mayagüez, May 1 (C.G.A.). First record from the West end of the Island.

Thamnotettix colonus Uhl. (Cicadellidae, P.W.Oman det.) collected at light in Mayagüez, May 1 (C.G.A.). Recorded by Osborn from several localities but not from the coast at the west end of the Island.

Deltocephalus nigripennis DeL. (Cicadellidae, P.W.Oman det.) at light in Mayagüez, May 1 (C.G.A). Known only from type male from Boquerón.

Protalebra lenticula Osb. (Cicadellidae, P.W.Oman det.) 2 adults at light, Bayamón, May 17 (C.G.A.). Known only from type material from Coamo, Jan. 1929.

Psyllia minuticona Cwfd. (Psyllidae, P.W.Oman det.) at light, Bayamón, May 15 (C.G.A.). Only previous records is "common on *Inga vera* at Lares 1922 and thruout the coffee districts. (Wolcott's "List" p. 274).

Colpoptera brunnea Muir (Fulgoridae, P.W.Oman det.) at light, Mayagüez, May 1 (C.G.A.). Osborn says probably one of the forms listed by Wolcott under Carda sp. from several other localities; types from Utuado, Toa Alta and Ciales.

Acinopterus angulatus Laws. (P.W.Oman det.). Caught by sweeping weeds, Santurce, June 29 (C.G.A.). Only record for the North Coast.

Euryopthalmus obovatus Barber (Pyrrhocoridae, H.G.Barber det.) common as adults on branches and trunk of three orange trees at Peñuelas, Jan. 26 (R.G.O.). Apparently known from P. R. only by a female paratype.

Zelus longipes L. (Reduviidae, H.G.Barber det.). An adult resting on a guava leaf at Trujillo Alto, Oct. 23 (A.S.M.). Previously recorded from Trujillo Alto in 1912; elsewhere only in the mountains.

Icerya montserratensis R. & H. reported by Wm. Barbour, Chief Insular Forester, as found moderately infesting on May 4 a small

unknown native tree on the north slope of the Luquillo Mountains about 5 miles south of Luquillo at about 750 feet altitude.

Haptonchus luteolus Er. (Nitidulidae, E.A.Chapin det.) 3 adults in a decayed star apple fruit, Arecibo, Apr. 22 (C.G.A.). Little known in P. R.

Lobiopa insularis Cast. (Nitidulidae, E.A.Chapin det.) A great many adults on the bark of a tree of *Petitia domingensis* at Arecibo, Jan. 26 (C.G.A.) Little known in P. R.

Chysobothris megacephala C. & G. (Buprestidae, M.D.L. det.) An adult flew into the car of Raphael Rodríguez of the College of Agriculture while passing thru Isabela, May 18. In Wolcott's "List" as collected in 1922 but "date and locality unknown".

Xyleborous affinis Eichhoff (Scolytidae, M.W.Blackman det.) An adult at light in a hotel, Mayagüez, May 1 (C.G.A.) Listed from P. R. previously only by Leng & Mutchler.

Platypus rugulosus Chapuis. (Scolytidae, M.W.Blackman det.) 2 adults at light in a hotel in Mayagüez, Apr. 30 (C.G.A.). Only previous record is at light at Mameyes in 1913.

Lema dorsalis L. (Chrysomelidae, H.S.Barber det.) Adults numerous on the leaves and flowers of an unkonwn weed at Arecibo, May 24 (C.G.A.). Previously listed from Aibonito, Coamo, Boquerón and Caguas.

Disonycha laevigata Jacoby (Chrysomilidae, A.J.Mutchler det.) Often very injurious to beets, swiss chard, etc., was reported by S. Molinary, Agr. Agt. at Carolina as very abundant on the common weed "Jamón con huevo" (*Achyranthes Beltzickiana*) at Loíza during October; many adults were submitted for determination. Apparently a new food-plant for P. R.

Panagaeus quadrisignatus Chev. (Carabidae, L L.Buchanan det.) Adults at light in Bayamón, Apr. 17 (C.G.A.). Previously listed only from Aibonito and Guánica.·

Callopisma borencona L. & M. (Lampyridae, H.S.Barber det.). An adult on a pomarrosa leaf at Bayamón, Mar. 21 (R.F.). Not many locality records.

Callopisma emarginata L. & M. (Lampyridae, H.S.Barber det.). A small number of adults on orange fruits at Peñuelas, Jan. 26 (R.G.O.). Previously listed only from type material from: Mayagüez, Adjuntas, Río Blanco Valley and Utuado.

Psyllobora nana Muls. (Coccinellidae, E.A.Chapin det.). Two adults on a cashew nut leaf, Santurce, April 6 (A.S.M.). Little known in P. R.

Callosobruchus chinensis L. (Bruchidae, H.S.Barber det.). An adult on a pepper fruit in a crate from Isabela, Apr. 4 (C.G.A.). Apparently not often recorded in P. R. (See also under bean).

Eurema euterpe Mén. (Pieridae, Schaus det.). A small number of adults at Cidra, Feb. 26 (A.S.M.). Apparently little known in P. R. but easily confused with *E. portoricensis* according to Dr. Forbes.

Atrytone vitellius Fab. (Hesperiidae, Schaus det.). Caught in a net at Río Piedras, June 22 (C.G.A.). Apparently not recorded since 1922 but probably common in various localities. The larva is known as a minor pest of sugar cane.

Calisto nubila Lathy (Satyridae, Schaus det.). 3 adults caught on the trail up El Yunque mountain, back of Luquillo Mar. 13 (A.S.M.). Apparently only a few previous records but according to Dr. Forbes undoubtedly common and widely distributed.

Dichomeris manellus Mösch. (Gelechiidae, as *Dichomeris*, Busck det.). An adult on a pomarrosa leaf at Barceloneta, Mar. 22 (A. S.M.). Apparently known heretofore from P. R. only from type material, without definite locality Forbes, following Meyrick lists this as a *Trichotaphe* (Sci. Surv. P. R. 12:121, 1930).

Lymire flavicollis Dewitz (Syntomidae, Schaus det.). An adult reared from a pupa on a cucumber leaf at Caguas, Jan. 25 (R.F.). Previously recorded only from Naguabo, Coamo, Lares (Seín) and Palmas Abajas, back of Guayama (Hoffman).

Pseudosphinx tetrio L. (Sphingidae, Heinrich det.). One larva from Mona Id. (A.S.M.) which is apparently the first record for that place.

Epistor lugubris Drury (Sphingidae, Schaus det.). Adult at light in Santurce in December (A.S.M.). Recorded only from Río Piedras and Lares.

Syngrapha egena Guen. (Noctuidae, Schaus det.). An adult on a lima bean leaf, at Cidra, Feb. 5 (A.S.M.). Only previous published record is from Cayey but specimens are in the Ins. Exp. Sta. coll. also from Comerío.

Melipotis januaris Guen. (Noctuidae, Schaus det.) An adult at light in San Juan, June 23 (C.G A.). Apparently but little known in P. R.

Leucinodes elegantalis Guen (Pyralidae, Schaus det.). Adult at light in Bayamón, May 15 (C.G.A.). Previously only recorded from P. R. without definite locality or date but specimens are in the Cornell Univ. coll. (Forbes det.) from 7 different widely separated localities by various collectors.

Lipocosma hebescalis Mösch. (Pyralidae, Schaus det.). An adult at light in Bayamón, Apr. 17 (C.G.A.). Previously recorded only from the type but Dr. Forbes collected several specimens in 1930.

Cataclysta miralis Mösch. (Pyralidae, Schaus det.). An adult at light in Bayamón, Apr. 17 (C.G.A.). Previously recorded only from the type material, without definite date or locality but Dr. Forbes found it common on El Yunque and also collected it at several other localities in 1930.

Crambus fissiradiellus Wlk. (Pyralidae, Schaus det.). An adult at light in Bayamón, Apr. 17 (C.G.A.). Previously recorded only from P. R. without definite date or locality.

Crambus ligonellus Zell. (Pyralidae, Schaus det.). An adult at light in Bayamón, Apr. 17 (C.G.A.). Previously recorded only from "P.R." but Dr. Forbes collected a number of specimens in 1930.

Samia ecclesialis Guen. (Pyralidae, Schaus det.). 2 adults at light in San Juan, Apr. 24 (C.G.A.). Previously recorded from "P.R." but according to Dr. Forbes this is abundant and general and there are many specimens in the Cornell University collection.

Lamprosema ebulialis Guen. (Pyralidae, Schaus det.). An adult at light in Santurce, Dec. 4 (A.S.M.). Not previously recorded from P. R. but there are specimens in the Cornell Univ. coll. from El Yunque (Forbes, 1930) and Lares (Seín, 1930 or 1931).

Hunterellus hookeri Haw. (Encyrtidae, Mueseback det.), found on a window in a dining room in San Juan, Apr. 2 (C.G.A.). Only 2 previous records from P. R.

Christolimorpha plesius Vier. (Ichneumonidae, R.A.Cushman det.). An adult on a leaf of Psidium sp. at Mayagüez, June 12 (A.G.H.). Only previously known from type.

Notogonidea vinulenta Cress. (Sphecidae, S.A.Rohwer det.). Adults numerous on the blossoms of many grapefruit trees at Barceloneta, May 10 (C G.A.). Only 1 previous record—from Mayagüez (Van Zwaluwenburg's typewritten "List" of 1914).

Polistes crinitus var. *americanus* (Vespidae, G.A.Sandhouse det.). Adults numerous on the blossom of many grapefruit trees at Barceloneta, May 10 (C.G.A.). Apparently not before recorded from the north coast.

Polistes major Beau. and *Sceliphron coementarium* Drury (F. Seín det.). Sent in from Bayamón by F. Joglar Rodríguez from a grapefruit tree, Aug. 6. Both of these species were apparently unknown in the Island until this past year.

Exomalopsis globosa Fab. (Anthophoridae, G.A.Sandhouse det.). 1 adult in an automobile at Arecibo, Apr. 22 (C.G.A.). Previously

known in P. R. from only one record "tunneling in hard clay at Guánica (G.B.Merrill)."

Cycloptilum antillarum Redt. (Gryllidae, A. N. Caudell det.). A small number of nymphs on the leaves of a maga tree, *Montezuma speciosissima,* at Arecibo. May 24 (A.S.M.) an adult found in a house in Santurce, Oct. 20 (A.S.M.). Apparently little known in P. R.

Neorandania chalybaea Wied. (Stratiomidae, C.T.Greene det.). Many adults resting on grapefruits at Arecibo, Apr. 5 (R.F.). Little known in P. R.

Tabanus hookeri Knab. (A.S.M., Alan Stone det.). One adult, at light at Santurce, Feb. Not in Wolcott's "List" but recorded from Vieques Id., P. R. in Curran's First Suppl. to Diptera of Porto Rico. Described from Porto Rico (Ins. Insc. Men. 3(4): 48, 1919).

Volucella pallens Wied. (C.T.Greene det.). An adult resting on a *Termalia catappa* leaf, Arecibo, July 27 (M.Kisliuk) and an adult on an orange at Peñuelas, Feb. 25 (R.G.O.). Little known in P. R.

Chrysotus excavatus VanD. (Dolichopodidae, Aldrich det.). Adults on grapefruit in small numbers at Arecibo, Mar. 1 (C.G.A.). Previously recorded only from Aibonito.

Psilopus diffusus Wied. (Dolichopodidae, C.T.Greene det.) Adults resting on fruits in small numbers on several sour orange trees, Arecibo, Feb. 23 (C.G.A.). In Wolcott's "List" but without definite locality.

Proctacantha rufiventris Macq. (Asilidae, C T.Greene det.). 1 fly resting on a tropical almond leaf, Arecibo, July 27 (Max Kisluik). Stated by Wolcott to be "quite common" but only actually recorded from 2 or 3 definite localities.

Sigaloessa bicolor Lw. (Oscinidae, Aldrich det.). A moderate number of adults resting on leaves of several banana plants at Bayamón, Apr. 8 (C.G.A.). Recorded only from Coquillett's original record published in 1900.

Gonia crassicornis Fab. (Tachinidae, Aldrich det.) was reared from a cocoon of the Noctuid *Xylomyges eridania* Cr. Previously recorded by Jones and Wolcott (Jour. Dept. Agr. P. R. 6(1): 47, 1922) as a parasite of *Laphygma frugiperda* S. & A.

Archytas antillicola Curran. (Tachinidae, Aldrich det) One adult on trail up El Yunque mountain, Mar. 13 (A.S.M.). Known only from the types (1927) altho these were from several localities, mostly at the higher elevations also.

Drosophila repleta Woll. (Aldrich det.) Adults on window in dining room in San Juan, Apr. 1 (C.G.A.). Previously recorded only from 2 specimens, Santurce 1914.

THE RELATION OF ANTHER COLOR AND THE PROPORTIONS OF STARCH FILLED POLLEN GRAINS IN THE SUGAR CANE

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The arrowing or flowering of most commercial sugar cane varieties in Puerto Rico takes place from the last week in October to the middle of January. The most effective period for crossing work extends from the middle of November to mid-December. Previous to this period the numbers of arrows are limited and after this period the condition of the arrows is not so good. Emergence from the sheath or boot is slower, in many instances incomplete, irregular, and slower.

Within the limits of the material available it is desirable to obtain as many new combinations and as large a number of crosses within the combinations as possible. Where trained help is scarce it is desirable to have some rapid method of determining pollen fertility of the varieties to serve as males. Bannier (1) describes a suitable method but it requires more personnel than the writer has had available in carrying out his work at Río Piedras, P. R. During the years 1929 and 1930 the arrows and attached canes were cut in the late afternoon, brought to the laboratory, and placed in quart Mason jars with water and a quantity of 6 per cent H_2SO_3 sufficient to approximate a 1 : 3000 solution. The following morning when pollen shedding took place, samples were collected on slides and examined microscopically in a saturated solution of iodine in chloral hydrate. Counts of iodine positive and iodine negative staining pollen grains were recorded. Anther color was noted under field conditions. In 1931 with a larger number of unknown potential males coming into bloom it was realized that our methods would not permit us to do much more than make pollen observations if the methods were not changed. Hence the arrows were cut without the attached canes. Small samples were examined microscopically from florets unopened but just below those which shed pollen for that day. The arrows were then placed in sheets of newspapers between blotters and dried for 10 days to two weeks. Blotters were changed every 2–5 days. Further samples were taken at a later date and comprise the data presented in table II.

Pollen counts

In crossing campaigns previous to 1930 it was noted that varieties with purple or purplish anthers seemed to give larger counts of iodine positive grains than those with yellow. In order to observe any relation between degree of color of anther and iodine reaction a number of varieties were examined. They were grouped into three classes with respect to color of anthers. In 1930 pollen counts were made of 15 varieties. All arrows were taken from field plantings unless otherwise noted.

TABLE I

RELATION OF ANTHER COLOR AND IODINE REACTION 1930

Variety	No of pollen grains counted	Per cent Iodine Positive in		
		Purple Anthers	Med Pur- Anthers	Yellow Anthers
P.R 358	1069		37 04	
Co-281	1487		54 67	
SC 12-4 (Drums)	1439		57 19	
SC12-4	1335	89 97		
POJ-2878	1399		82 13	
P. R-492	205		56 10	
POJ-2725 (Collection)	1110			3 93
POJ-2725	No count			Less than 1
Kassoer	740	51 61		
Tuc-472	1349	72 45		
POJ-2364	869			1 62
Badilla	555		49 91	
POJ-36	No count			Less than 1
D-1135	1204	66 03		
Tuc-450	613	66 07		
Tuc-454	513		51 85	
T-2009	1028		77 62	
Average		71 74	60 25	2 91
Maximum		89 97	83 13	3 93
Minimum		51 61	37 04	1 62

The assistance of Miss Ana Molina, Inst. in Biology, U P R, in making most of the counts in table I is hereby acknowledged.

In general the data seem to show that intensity of purple coloration of the anthers is some indication of the fertility of the enclosed pollen grains. Undoubtedly as between yellow and purple of medium or better, the latter are to be preferred for use as males. It is interesting to note that in the case of SC 12-4, pollen from field grown plants had a higher percentage of iodine positive pollen grains and more intense purple color than those grown in drums.

In 1931 notes were available on 41 varieties and they were grouped according to anther coloration into 4 classes. The data presented in table II are based on the sum of the counts of the first and second samples as mentioned above. There is essentially no difference between the counts made in November 1931 and those made in August

1932. The correlation coefficient between the two series of observations was 0.642 ± .059. See table II.

TABLE II

RELATION OF FRESH AND DRY FLOWERS

Percent Positive November 1931	Percent Positive August 1932: 0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	
0-10	14	1	1		1					17
11-20	1			1						2
21-30			3	2	1					6
31-40	1			1	1					3
41-50				1	2		1			4
51-60					3	3				6
61-70					1			1	1	3
71-80		1	1							2
						1		1		2
	16	2	5	5	9	4	1	2	1	45

NOTE: The discrepancy in total observations between tables II and III is due to the fact that anther color determinations were lacking in 4 cases.

TABLE III

RELATION OF ANTHER COLOR AND IODINE REACTION 1931

Purple Anthers			Med Purple Anthers			Tinged and Light Purple Anthers			Yellow Anthers		
Variety	No Pollen grains	Per cent Iodine Positive	Variety	No Pollen grains	Per cent Iodine Positive	Variety	No Pollen grains	Per cent Iodine Positive	Variety	No Pollen grains	Per cent Iodine Positive
PR 26-14	930	69 9	POJ-2878	718	27 0	PR-334	500	47 0	POJ-36	750	0 0
PP-26-8	772	59 3	Al-32	506	30 2	PR-358	474	34 8	G-119	750	0 0
			PR-507	649	55 5	PR-422	849	56 5	POJ-2883	700	0 0
			US-875	577	52 4	PR-202	705	35 2	PR-728	435	24 2
			PR-702	732	50 0	Al-15	1408	0 59	Tuc-521	425	2 8
			Co-281	859	37 0	Tuc-450	556	5 8	POJ-2364	750	0 0
			PR-701	717	74 9	PR-547	1180	47 2	Tuc-491	500	0 0
			PR-208	421	74 6	Tuc-472	1294	11 2	POJ-2725	500	0 0
			PR-207	638	70 9	Tuc-454	1016	0 17	CP-807	850	0 0
			PR-357	547	32 0	PR-720	725	54 0	PR-440	763	11 7
			PR-26-187	735	45 0	Co-213	576	26 4	POJ-36M	700	0 0
			PR-338	613	44 0	POJ-2822	879	35 0	CH-64-21	700	0 0
						Ba-11569	1026	8 0	Merthi	700	0 0
									PR-807	700	0 0
Total	1702	65 1		7712	48 9		11188	27 7		9228	2 25
Maximum		69 9			74 9			56 5			24 2
Minimum		59 3			27 0			0 17			0 0

The 1931 data show a similar trend of the average per cent of positive reacting pollen grains to increase with the increase in intensity of the anther color. The range and therefore the variability is very high in both years.

If we may assume that arrows with 50 per cent fertility as indicated by the iodine test are worth using as parents then anything below medium in color should be only used after a microscopical examination with iodine has been made. Of course all varieties used as males should be checked up for pollen fertility by the iodine test sooner or later.

SUMMARY

1. It has been shown that within rather wide limits there is a positive relationship between pollen fertility as indicated by the iodine test and the degree of anther coloration in the sugar cane.

2. That pollen samples taken from dried flowers nine months after the fresh samples have been taken are similar in their iodine reaction has also been demonstrated.

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BACTERIAL WILT OF TOBACCO IN PUERTO RICO AND ITS INTERTRANSMISSION TO OTHER SOLANACEOUS HOSTS

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Although bacterial wilt of the Solanaceae has been repeatedly reported by various investigators from Puerto Rico, Henricksen (2), Stevenson (9), Stevenson and Rose (8), Smith (7), Thomas (11), López (4), Seaver and Chardon (6) Cook (1), and more recently by Nolla (5), attacking tomato, eggplant, pepper, potato and other plants*, the disease has never been found naturally in tobacco nor has been produced artificially by inoculation with supposedly pure cultures of *B solanacearum* E. F. S. from other hosts. Cook (l.c.) suspected the pathogene to be a different one when his cross inoculations with the organism from eggplant succeeded on tomatoes and peppers but failed on tobacco. Nolla (l.c.) in a very comprehensive study of the disease concluded that the Puerto Rico organism, although morphologically similar to *B solanacearum* E. F. S. was a strain incapable of infecting tobacco. He suggested, however, the possibility of all varieties of tobacco on the island being resistant to the organism.

The present investigation was initiated with the purpose of ascertaining why tobacco was not attacked by the Puerto Rican strain and, if so, the relationship between the tobacco organism and the one attacking other Solanaceous hosts of economic importance, viz., tomato, eggplant, pepper and potato. With the introduction of new tobacco varieties as a means of improving our standard types and, more recently, with the expansion of the vegetable growing industry into what was formerly tobacco land, the importance of elucidating this point not only has a purely scientific value but also a decided economic importance.

History

The writer found what was apparently the first observed case of bacterial wilt on tobacco in Puerto Rico in the summer of 1931, among two of our standard varieties, Ceniza and Utuado, growing in a field that for the last 10 years has been planted with sugar cane and, more recently, with strawberries. The plants were about 18

* Zinias (*Crassina elegans* (Jacq) Kuntze); *Solanum torvum* L.; *Solanum caribaeum* Dunal Undoubtedly many other plants are attacked under our conditions.

inches high and growing rapidly. Two of the Utuado plants were carefully pulled and their root systems washed. No symptoms of fungus attack was evident and the roots, except for the end of the main branch, appeared to be healthy. After stripping the plants of their leaves, the greater part of the stem was cut off until almost a solid core of woody tissue near the base of the stalk was left. The roots were then set in a beaker with distilled water in such a way as to leave the stub above the surface. In a few minutes, a slimy, brownish exudation appeared on the cut surfaces. A microscopic examination of the exudate, revealed the presence of enormous numbers of motile, rod shape organisms, similar in morphology to *B. solanacearum* E. F. S.

Agar plates from sterile water suspensions of the ooze failed to develop colonies after five days, but streaks made directly from the exudate made good growth. From these slants, agar plates were poured which in 48 hours developed watery, translucent colonies. Sub-cultures were then made from these colonies and in eight days developed the typical brown pigment characteristic of this organism.

Morphologic Symptoms

In the Field.—The symptoms of the disease when occurring naturally in the field are typical and distinct. The first indication is the sudden wilting of one or more of the youngest leaves. When only one leaf wilts it is usually the third or fourth youngest from the top. The leaves wilt either totally or partially; when partially, the tip or only the area of the blade at either side of the midrib withers; when the whole leaf wilts, it droops, so that only the ventral side of the leaf is visible. The wilting and drooping of a single leaf near the top is an unmistakable early symptom of the disease. These early manifestations of infection are usually evident late in the morning hours when a bright day follows previous heavy rains.

If the variety is resistant to the malady, the symptoms progress no further and in a week or two the plant completely recovers. Because of the fact that all of our standard varieties are highly resistant to infection, as will be demostrated further on, this may explain the reason why the disease has been previously overlooked.

In case of susceptible varieties, successive wilting of the other leaves follows, usually the older ones, and the normal growth of the plant is checked so that adjacent healthy plants shortly outgrow them. Wilting is not uniform along the plant, but usually one side is more wilted than the other or not wilted at all. Wilted areas may show a slight yellowish discoloration, but a marked chlorosis is not

typical. The leaves finally rot, in some cases, only the stalk with a few stripped midribs remaining. If hot dry weather follows the initial symptoms, the leaves are irregularly scalded, in a short time dry up, become brittle and desintegrate. With moist weather, the leaves gradually turn yellow, then brown and finally rot without becoming brittle In advanced stages, the stem blackens, becomes hollow and shrivels up.

When the roots of diseased plants are examined, dark grayish to black, slightly sunken blotches are often present in the main branches. Usually the rootlets arising from these branches are dead and their cortex is easily removed. When cross sections of the affected roots are made, droplets of a slimy ooze appear on the cut surfaces. For diagnostic purposes this is the critical evidence of infection by bacterial wilt.

Under Puerto Rican conditions, the writer had no difficulty in differentiating between fungus wilt as produced by *Rhizoctonia solani* Kühn, *Phytophthora parasitica* var. *nicotianae* Tucker, and bacterial wilt, as soon as the early symptoms of both types of infection are evident. In the former cases, the wilting is sudden and general, that is, practically all the leaves wither and droop simultaneously and a marked chlorosis is immediately noticeable. Wilted plants do not recover rom day to day with the advent of moist weather and cloudy mornings as plants attacked by bacterial wilt do in the early stages. So clear cut is the difference that the writer never failed to obtain critical signs of bacterial wilt on plants marked as such as soon as the first symptoms were observed.

Symptoms were observed at all stages of growth from three weeks after setting plants in field.

On Inoculated Plants.—The symptoms manifested by inoculated plants in pots were identical in every respect to those observed under field conditions, especially so, in the early stages. Inoculated plants, however, seldom were completely destroyed; partial or complete recovery being oftener the case. In many instances, recovered plants would exudate the slimy ooze even when cut 10 inches above the point of inoculation.

Brown and sunken longitudinal streaks along the stem were often produced by inoculated plants, but this symptom was never observed in the field. When these areas are punctured, exudation of ooze follows.

Dwarfing and undeveloped root systems are also pronounced symptoms of inoculated plants.

Histologic Symptoms

Bacterial wilt is primarily a disease of the vascular tissues of the plant. In tobacco as well as in other suscepts studied, however, the pith is nearly always affected and in many cases also the cortex.

Tranverse sections of affected parts of the roots or stems shows the vessels completely occluded with the bacterium. There is a pronounced discoloration of the wood which varies in color from reddish brown to dark brown. Shortly after the cut surfaces are exposed a sticky exudate oozes out of the vessels in tiny droplets which rapidly enlarge and coalesce. Both the consistency and the color of this ooze varies with individual cases, in some instances being watery while in other it is very thick. The color varies from pearl white in plants recently infected to a very dark brown in advanced cases, although individual droplets from the same stem may differ among themselves as to color.

The pith is nearly always affected and when the attack is severe it is rapidly disorganized. As a result the stem collapses, forming indentations and twisting around. It is also stained brown, but to a lesser degree than the woody tissues. In some cases the bacterium invades the cortex forming necrotic areas which enlarge with the advance of the infection. The woody tissues, although becoming functionless, are not disorganized until invaded by secondary saprophytes.

Etiology.

Morphological, cultural and pathogenecity studies establishes the organism responsible for bacterial wilt of tobacco in Puerto Rico as identical to *Bacterium solanacearum* E. F. S. (*Phytomonas solanacearum* (E. F. S.) Com. S. A. B.)

The pathogene is extensively disseminated throughout the island and is responsible for a similar disease in other Solanaceous hosts among which tomato, eggplant, pepper, and potato are the most important.

Morphological and Cultural Characteristics.

The following characteristics are typical for the organism under discussion:

Rods, 0.5 μ in width, varying in length from 1.0 μ to 1.5 μ; motile by a single polar flagelum (two preparations stained by Cesares—Gil method) which is 3 or 4 times longer than the cell; motility is best observed in hanging drops of fresh ooze or in broth cultures 48 hours old at room temperature (25° C. to 30° C.). The cells stain well

with ordinary anilin dyes but specially so with carbol fuchsin. In good preparations a more pronounced staining of the polar regions as well as a plain constriction at the center are evident.

Standard nutrient agar plates begin to show surface colonies in from one to two days; in general these are small, circular and slightly raised, transparent at first, resembling tiny drops of water on the surface of the agar, changing to whitish when seen by reflected light in one to two days, but brownish by transmitted light and producing a brown pigmentation which varies in intensity from very light to dark brown after a week old, and diffuses into the agar. Sub-surface colonies are variously shaped, usually elliptical.

Nutrient agar and litmus lactose agar slants show a filiform type of growth; the agar in the latter case acquiring a more intense blue color with age particularly near the region of growth. The streaks are semi-liquid during the first few days and run into the condensation water if kept upright.

Gelatin stabs show no liquifaction when two weeks old.

Milk is cleared without precipitation of the casein and the medium acquires a bright brownish hue. Litmus milk becomes more intense blue with age without precipitating.

Broth cultures become clouded in 24 hours when a recently isolated culture is used; old cultures require a longer time for clouding the medium. In a few days a white precipitate is deposited at the bottom of the tube and the liquid becomes intensely clouded, with or without the formation of a very slight pelicle. As the cultures become old, the supernatant liquid becomes clear and develops a color which varies from amber to dark brown.

Growth on potato slants is at first watery, spreading, whitish or yellowish in color, later turning brown and the water becoming heavily clouded.

On Dunham's solution growth is similar to that of broth cultures No growth has been observed on Cohn's solution.

No gas or acid is produced from saccharose, dextrose, glucose, maltose, lactose or mannit broths.

Nitrates are not reduced; indole is not produced.

Spores have not been observed. The organism is aerobic and gram negative.

The length of time for which the organism remains viable in pure cultures is variable; good growth has been obtained from broth cultures three months old. Liquid cultures remain viable for a longer period than cultures on solid media.

The above description of cultural and morphological characters corresponds to the ones given by Smith (l.c.), Stanford and Wolf (**10**), Nolla (l.c.) and other investigators elsewhere for *B. solanacearum* E. F. S.

INOCULATIONS

Methods and Inoculum.—The irregular behavior of plants inoculated with *B. solanacearum* E. F S., was first noted by Smith (l.c.) and confirmed by practically all investigators on the subject since then. Similar difficulties were encountered by the writer. These were augmented by the fact that the organism rapidly or immediately loses its pathogenic ability when artificially cultured.

In an effort to obviate these difficulties, several methods were tried in the early stages of these studies, two of which were finally adopted in conducting inoculations and cross-inoculations with marked success.

Both the aerial and the underground parts of the suscepts were inoculated. Except in two or three instances, all inoculations performed above ground failed. They even failed when conditions for the development of the organism at the point of inoculation were provided. Identical inoculum, when used simultaneously underground, on plants grown alike, would reproduce the symptoms of the disease.

Sub-cultures from poured plates; broth cultures made directly from ooze or from sub-cultures; streaks made directly from ooze; colonies from poured plates; sub-cultures on potato slants; ooze directly from diseased plants, and pieces of diseased wood were used as sources of inoculum. Except when ooze or pieces of wood were used, the age of each of the various cultures employed varied in from 1 to 7 days. Pieces of wood were invariably used the same day and ooze was used when not more than 48 hours old.

Of these, agar streaks made directly from ooze, pieces of wood and pure ooze were the most successful sources of inoculum; the last two mentioned giving very consistent results. Nolla (l.c.), pointed out that inoculations with ooze scarcely ever failed.

Symptoms produced by sub-culture inoculations no matter on which medium grown were usually of a localized nature; there is a slight brownish discoloration following the vascular bundles for a short distance below and above the point of inoculation or the pith was sometimes affected. Critical symptoms, however, were rarely, if ever, obtained.

In performing most of the inoculations upon which the conclusions arrived at in this paper are based, the usual procedure was to inoculate young, rapidly growing plants in 8-inch pots in sterilized soil, about one inch below the surface of the ground, either with ooze or with pieces of diseased wood from the same or other suscepts studied. The necessary ooze was obtained from roots and stems of recently wilted plants in the field The soil around the stem near the surface of the ground was carefully removed and the stem washed with distilled water at the desired place. A slight injury with the end of a sharp scapel so as to pierce the woody cylinder was made and the ooze inserted at that point. The soil was then replaced and the plants watered once or twice a day until discarded. Checks were similarly treated, except that no inoculum was provided.

When pieces of diseased wood were used, thin slices of the material were cut with a sterile razor in such a way that one side of the section was thicker than the other, and kept in sterile water until used. With a sharp scapel, a longitudinal cut was made after proceeding as above. The end of the scapel was not removed until, with a pair of tweezers, the slip of wood, thinner edge first, was inserted into the cut. The whole scheme is in the nature of an underground graft.

Thes two methods were equally successful, but because of the large amount of ooze required when making extensive inoculations, the latter was much more convenient.

Pathogenicity.—Tobacco plants inoculated as above from naturally wilted plants developed typical wilt symptoms in from 4 to 10 days. When resistant varieties were used recovery slowly followed these early symptoms; when susceptible varieties were inoculated, the symptoms usually terminated in the death of the plants.

Broth cultures of the inoculum were plated when two days old and sub-cultures made. Soon after the symptoms on inoculated plants were well defined, the plants were pulled, washed and examined for the critical sign of infection: exudation of ooze for some distance above or below the point of inoculation. Sub-cultures of this ooze made as above were then compared with the original ones. In every case, they were found to be morphologically and physiologically identical.

Agar plates from broth cultures of the ooze nearly always yielded a single type of colony with slight or no contaminations. This is particularly the case when fresh ooze from recently wilted plants is collected as far up in the stem as possible. Parallel inoculations with these typical colonies with few exceptions failed, while those made

with ooze were successful. This points to the rapidity with which the organism losses its infective powers. Sometimes abundant fungus contaminations (*Fusarium* sp. and *Actinomyces* sp.) would appear in the plates. In these cases, the results obtained from ooze or wood inoculations were not considered.

In all inoculation work done, an average of two checks for every 10 plants treated were carried. They always failed to show the disease.

Intertransmission.

Nolla (l.c.) has shown that *B. solanacearum* E. F. S., as occurs in Puerto Rico, is intertransmissible to tomato, eggplant, pepper and potato. In an effort to establish the pathogenic relationship between the tobacco organism and these hosts, over 500 inoculations were made, more than one-half of which were successful The routine procedure was to determine first the pathogenicity of the ooze from each suscept on itself and then to make direct and reciprocal inoculations between each of the five species under study.

Sufficient positive reactions were obtained in each case to warrant the conclusion that the organism responsible for bacterial wilt of tobacco in Puerto Rico is equally pathogenic to the other hosts under consideration and they, in turn, are equally pathogenic not only among themselves but also to tobacco

Varietal Susceptibility.

Through the courtesy of Dr. R. F. Poole, of the North Carolina State College of Agriculture, the writer received seed of three flue cured varieties of tobacco: Cash, White Stem Oronoco and Adcock, known to be susceptible to bacterial (Granville) wilt. When tested, the Adcock seed failed to germinate.

In the Summer of 1931, 200 plants of each of the Cash and Oronoco varieties were grown in a field known to be heavily infested with the organism, as demonstrated by the high incidence of infection when either tomatoes or susceptible eggplants were grown on it. They were planted alternately in 10 rows, 3 ft. apart, 40 plants to a row. Hot, rainy weather followed for weeks after transplanting to the field. A perfect stand was secured by continued replantings. Notes on incidence of wilt were taken once a week, as soon as the first symptoms * were observed. The results are given in table 1.

* Before finally recording any plants showing symptoms as positive, a critical tion for bacterial exudate was made.

TABLE I

INCIDENCE OF WILT ON TWO IMPORTED TOBACCO VARIETIES

Variety	Population	Healthy	Wilted	% Wilted
Cash	200	87	113	56 5
White Stem Oronoco	200	53	147	73 5

The results demonstrated that these varieties are highly susceptible to the disease under favorable conditions for infection.

A more extensive trial was conducted in the same field early in the Spring of 1932. Besides the above mentioned types, our three most popular varieties: Virginia, Ceniza and Utuado, and a vigorous variety brought from Colombia in 1929 by Dr. J. A B. Nolla, were included in the test. The same plan of planting as explained in the previous trial was followed. The weather was cool and dry at the time of planting and remained so for two or three weeks after. In consequence, the plants failed to grow rapidly and the symptoms of bacterial wilt appeared very late, even at flowering time with the early varieties. Symptoms of fungus wilt, however, showed much earlier and to such an unexpected extent that it became obvious that this factor had to be taken into consideration in analyzing the results. These are given in table 2.

TABLE II

INCIDENCE OF FUNGUS AND BACTERIAL WILT ON LOCAL AND IMPORTED TOBACCO VARIETIES

Variety	Population	Plants infected with fungus wilt *	Percent infected with fungus wilt	Plants infected with bacterial wilt	Per cent infected with bacterial wilt from total No of plants	Per cent infected with bacterial wilt from healthy plants only **
Virginia	180	39	21 66	15	8 33	10 63
Utuado	201	22	10 95	18	8 99	10 05
Ceniza	202	65	32 12	13	6 43	9 48
Cash	201	98	48 75	23	11 44	22 33
Oronoco	204	63	30 88	46	22 54	32 62
Ambalema	212	33	15 56	30	14 15	16 75

* *Rhizoctonia solani* Khun and *Phytophthora parasitica* var *nicotianae* Tucker

** The per cent of bacterial wilt from healthy plants only, i e, from those remaining after deducting the ones infected with fungus wilt

The writer is inclined to consider the percentage obtained in the last column as a more accurate estimate of the true incidence of infection for each variety under the conditions of the experiment because the early invasion of plants attacked with fungus pathogenes prevented the infection with *B. solanacearum*, which, as stated, developed much later in this particular trial. Furthermore, not a single plant attacked with fungus wilt was found to be also infected

(6) **Seaver, Fred J.** and **Carlos E. Chardon.**—Botany of Porto Rico and the Virgin Islands. Mycology. Sci. Surv. of Porto Rico and the Virgin Islands, New York Ac. Sc. **8**: 1–208. 1926.

(7) **Smith, E. F.**—Bacteria in Relation to Plant Diseases. Carnegie Inst. of Washington, Publication 27, **3**: 1–309, 1914.

(8) **Stevenson, J. A.** and **R. C. Rose.** Vegetable Diseases. Porto Rico Ins. Exp. Sta. Rept. **1916–17**: 85, 87. 1917.

(9) **Stevenson, J. A.**—A check List of Porto Rican Fungi and a Host Index. Jour. Porto Rico Dept. Agri. **2**: 125–264. 1918.

(10) **Stanford, E. E.** and **Wolf, F. A.**—Studies on Bacterium solanacearum. Phytopath. **7**: (3) 155–165. 1 fig. 1917.

(11) **Thomas, H. E.**—Report of the Plant Pathologist. Porto Rico Agr. Exp. Sta. Ann. Rept. **1917**: 1–40. 1918.

EXPLANATION OF PLATES.

PLATE I.—Two nutrient agar plates using different dilutions from a broth culture made directly from tobacco ooze. Only typical colonies of *B. solanacearum* developed. This ooze was used to inoculate plants shown on plate II.

PLATE II.—*Upper:* Plants of the "Ceniza" variety artificially inoculated with bacterial ooze from wilted tobacco plants, photographed 10 days after the inoculation. Plants at left and right are showing typical symptoms. Middle plant, check.

Lower: Same as above using plants of "Utuado" variety.

PLATE III.—At left naturally wilted plant and at right healthy plant of the imported variety "Cash".

PLATE I.

PLATE II.

CONCERNING THE ORIGIN OF THE WHITE QUARTZ SANDS OF NORTHERN PUERTO RICO

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There are numerous deposits of white quartz sands of varying depths which are distributed in belts and spots from a few miles southeast of San Juan to a point about 4 miles southeast of Quebradillas. The largest deposits occur between San Juan and Manati. Nearly every scientist who has observed these sand deposits has conjectured as to their origin and several have offered tentative theories. Most writers have merely mentioned them without attempting to offer an explanation of how they were accumulated.

The writers had the opportunity to study these white sands in great detail while making a soil survey of the districts in which they occur in abundance. We herewith submit our findings and we believe that we have been able to explain, at least in part, the methods and forces which have caused the accumulation of these deposits.

For the benefit of those unfamiliar with these sands a brief description of them and their environment is in order. The "white sand" deposits consist of white or gray quartz sands which vary in depth from a "smear" of a few inches to dune-like deposits 15 feet or more in thickness.[2] Usually the surface six or eight inches of these sandy areas will be light gray colored while the subsoil will be nearly white. In many places the water table is reached at from 20 to 50 or more inches depth. In these places the white sands are

[1] The authors are indebted to the Director of the Insular Experiment Station, Mr. F. A. López-Domínguez and assistants Messrs. Jorge Landrón and David Rodrigues for their helpful cooperation in the prosecution of the soil survey of the north coast which furnished the basis for much of the contents of this paper. We are also greatly indebted to Dr. N. L. Britton of the New York Botannical Garden, Chancellor Carlos E. Chardón of the University of Puerto Rico, and Dr. H. A. Meyerhoff of Smith College for valuable suggestions. Dr. C. F. Marbut, Chief, and Mr. Mark Baldwin, Inspector, of the Bureau of Chemistry and Soils furnished valuable criticism and suggestions which have greatly added to the value of the paper. Messrs. Ray C. Roberts and A. T. Sweet, of the U. S. Bureau of Chemistry and Soils; and Messrs. Juan Zalduondo and Fernando A. Villamil of the Insular Experiment Station furnished soil maps of the San Juan district which were of great use in studying the distribution of white sands in that region.

[2] Cook and Gleason (3) in their "Ecological Survey of Puerto Rico", published in the July, 1928, issue of the Journal of the Department of Agriculture of Porto Rico, describe the white sands in part as follows: "The soil is composed of white, *calcareous* (italics ours) sands of unknown depth." As a matter of fact these white sands are practically pure quartz and their acid reaction demonstrates that they are distinctly non-calcareous. Possibly the sands were confused with nearby shell sands which are highly calcareous. It is commonly believed among the farmers of the northern coastal region that these sands consist of limestone grains.

underlain by a heavy, columnar and highly acid clay which is exceedingly difficult to penetrate with digging tools. This clay is usually gray in color with streaks and blotches of bright red or yellow or both. The thickness of the clay varies and is known to be more than 15 feet deep in places. The cracks and root holes are usually lined with white leached clay (probably kaolin). The sand, where it contacts the clay, is usually stained dark brown or dark gray and is often cemented into a "hardpan". Superficial observation would lead one to believe that this cementing material consists of iron oxides (limonite) but if the "hardpan" is ignited the dark color disappears and leaves a white or sometimes a pale yellow sand. It is evident, therefore, that the cement is of organic material. In a few places it was observed that the hardpan layer was partly of iron and partly of organic material. When the hardpan from these latter places is ignited the organic part of the cement burns out and the residue, owing to the effect of iron oxide, assumes a light red or or pinkish color.

The underlying clay material, when it is exposed in a ditch bank or road cut, exhibits a strong tendency to form vertical columns. These columns break up into well defined prisms of varying sizes which are very hard when dry and exceedingly stiff and resistant to pressure when moist. In the wet condition a good degree of plasticity develops.

There are many places where the white sands lie on knolls or on gently sloping hillsides and a few places where the slope is quite steep. At first sight one would expect that the natural drainage would be good or even excessive in these places. This is frequently true but in many apparently well drained areas there is a heavy, tight clay like that described above which holds up the descending waters after rains and causes the lower layer of white sands to be wet much of the time. In these places, just as in those described in the foregoing an organic hardpan forms. The places where the white sands have good subdrainage do not have well developed organic hardpans and in some places even dark organic stains are lacking.

Where the white sands are deep they tend to blow up into low dunes and to spread out into layers of varying thickness over adjacent soils. In places where the latter has occurred one does not, of course, find the normal profile development.

All of the sands observed occur within the belt of land where the Tertiary limestone forms the bedrock. Britton (1), Chardón and others have suggested that these sands may be the residuum left

from the weathering of these limestones. There is much evidence to support this hypothesis. The Tertiary limestones have been weathered in a manner peculiar to the tropical regions. Except for small areas where the large rivers have cut their way through from the interior of the island, surface alluvial erosion is negligible. Underground streams remove most of the water which falls on the Tertiary limestones and these streams are fed by water which seeps down through the porous limestone and sinkholes. Differential solution of the limestones has led to the formation of myriads of "solution valleys" and intervening *"mogotes", "pepino"* (cucumber), or "haystack" hills. These "haystack" hills are closely spaced in places and in other places stand out in isolated groups or in rows in the larger open valleys.

Where the white sands occur in "solution valleys" which are entirely surrounded by high hills there is no other probable source for them than the limestone itself. There seems to be little if any doubt that this is the case. The writers with this in mind, made a large number of observations to see whether the limestones contained quartz sand in sufficient quantities to account, not only for the white sands but also for the sands which occur in the valley soils which are red, brown, or yellow in color. It was found that there are many layers of limestone which contain more or less sand and there are a few thin interstratified layers of clays and sands which contain little or no lime. Dr Britton (1) once observed sandy layers in the limestones near San Juan and our more extensive observations have confirmed his findings. Places where these sandy layers may be easily observed are in the vicinity of Almirante; six miles southwest of Arecibo on the Lares road; 4 and ½ miles southeast of Hatillo; and on the Camuy River trail 5 and ¼ miles southeast of Camuy, 300 yards before the river is reached. In the latter place there is a 3 or 4 foot thickness of limestone which, perhaps, contains as much as 30 per cent of quartz sands. A sample of decayed limestone from 4 and ¼ miles southeast of Hatillo was examined by Fry of the U. S. Bureau of Chemistry and Soils and he estimated that it contained 25 per cent of quartz sand. The sandiest soils of limestone derivation and the areas of white sand were observed in the localities where it was definitely determined that the limestones contained appreciable quantities of sand. This is by far the most plausible explanation of the origin of the white (and other) sands of the localities which are *remote from the seacoast.* The dissolving of great thickness of these limestones would readily account for the accumulation of sands in the "solution valleys". It might be observed in passing

that the sandy limestones occur in the transition zone between the youngest of the Tertiary beds and the second youngest. These different divisions have been described by Hubbard (5), Meyerhoff (9) and others. Meyerhoff[a] suggests the possibility of artesian springs bringing up the sands from underground, but we observed no place where this would seem to be a plausible explanation.

The largest beds of white sands occur fairly near the seacoast at distances varying from ½ mile to 2 and ½ miles. The limestone hills between them and the ocean are often quite low and rounded and in many places it seems quite possible that sands from the beaches may have been blown over the hills by the prevailing northeast trade winds. One of the largest deposits occurs 1 and ⅕ miles southwest of Arecibo. In this place the sands occur intermittently over a large U-shaped area the two arms of which extend in a west-southwest direction. Over most of this area the sands lie on a nearly common level and comprise flattish bench-like deposits. Numerous deep sinkholes indent this flattish area and it is surrounded by low-lying, rounded limestone hills. A few of the white sands in this district are on the tops of low rounded knolls and above the average level of the main body. The sands of the northern arm and eastern end of this area grade into acid brown sands which are frequently underlain by heavy clay subsoils similar to those under the white sands. Several large areas of the brown sands have a sandy iron hardpan layer between the soil proper and the subsoil. These acid brown sands, in turn, grade into alkaline brown quartz sandy soils as the coast is approached. These latter sands are without doubt largely derived from the disintegration of the San Juan consolidated sand dunes the sands of which are being broken apart by the waves on the seacoast and spread inland by the trade winds. It should be remarked for the benefit of those not familiar with the San Juan sand dunes that they were originally piled up by the trade winds on a bar near the shore and have subsequently been cemented by lime. This cement was very probably formed by a deposition of lime which resulted from the evaporation of sea spray. Some of the lime may also have come from the solution and redeposition of the lime of sea shell fragments. Probably the acid brown sands which are farther inland than the alkaline sands were largely derived from the sands which have spread inland from the coast through the agency of wind. They are acid because the leaching of the lime in them

[a] In 1931–32, Dr H. A. Meyerhoff of Smith College, delivered a series of lectures at the University of Puerto Rico. These lectures are to appear in book form at an early date and their author very kindly permitted us to read the manuscript.

has exceeded the rate at which the limy material from the coastal sands has been supplied. At the present time there is very little transportation of material taking place because of the fact that grasses and bushes are holding the sand in place.

It may be readily surmised from the above that at least a part of the white sands near Arecibo have been derived from brown sands which have been blown inland from the coast. The present pale gray or white color is due to excessive acid leaching by ordinary soil forming processes. These processes will be discussed later in greater detail.

Another possible explanation of the presence of a large body of white and gray sands near Arecibo is that there may have been an old lake, swamp or estuary in this locality and the sands may have been deposited along its shores or on the bottom. A deposit of white sands now borders Laguna Tortuguero farther to the east. The great thickness of heavy mottled clay under the white sands lends credence to this theory. Another evidence to lend support to the theory of an old estuarine or lake deposition is the fact that it is well known that the coast line between Arecibo and Aguadilla has been much lower in the past. High wave-cut terraces are to be discussed in Meyerhoff's "Geology of the Arecibo District" so we shall not discuss them further here.

In many places between Manatí and San Juan the deposits of sand are very deep and in many of these places there is unquestionable evidence that they have been reworked by the wind since original deposition.

Between San Juan and Carolina there are deposits of white sands surrounding swampy and mucky areas where the evidence seems to be in favor of lagoon shore deposition. Granting the idea of some of the sands having been old beaches, we still may be permitted to wonder from whence the sands were originally derived. We may still logically suppose that a fair share of them came from the dissolution of the Tertiary limestones and perhaps a part of them from the weathering of the nearby San Juan formation. If we must go back to first beginnings the quartz grains doubtless came from the weathering of granites and other siliceous rocks of the "oldlands" of the interior. The rivers carried the sands down and the waves and currents spread them out over the Tertiary sea when the limestone strata were being built up.

Up to the present point in our discussion we have devoted our remarks almost entirely to the explanation of the different probable sources of the white sands with scarcely any mention of why they

are *white* instead of brown, yellow or red like the other sands with which they are closely associated. The answer to the latter question is one which may be best referred to soil science. Soils quite similar to the white sands of Puerto Rico occur abundantly in the south-eastern coastal plains of the United States. They are especially abundant near the Atlantic seacoast in Georgia and Florida but occur in scattered localities somewhat farther north than Lakewood, New Jersey. The areas of white sands in Puerto Rico which have a high water table are very much like the *León* and related sands of the coastal plains of Georgia and Florida, while the deeper sands are much like the *St. Lucie* soils of Florida. The shallower types, which are well drained, resemble the *Lakewood* sands which are distributed from New Jersey well into the southern states. Hearn (4) estimates that there is a total area of about 4 or 5 million acres of the *León* sand alone. This is about twice the total area of Puerto Rico The *Lakewood* and *St. Lucie* soils in their turn occupy a tremendous additional area. Cobb (2) observed similar sands in France and Bennett found a few areas of *León* sands in Nicaragua. It should be plainly understood at this point that there are several minor points of difference between the different types of white sands in Puerto Rico and the similar types on the United States mainland. We cannot, therefore, call them by the same names. Soils of the *León* series are characterized by a dark gray, strongly acid, sandy surface about 4 inches thick, about 18 inches of white quartz sand and a 10 inch organic hardpan just above the water table which occurs at about 32 inches from the surface Beneath the hardpan there is normally a loose wet yellowish sand to considerable depths. In some places, however, the hardpan is underlain by a stiff mottled clay just like the clay layer underlying much of the Puerto Rico white sands. The deeper white sand deposits of Puerto Rico more closely resemble the *St. Lucie* sand of Florida which consists mainly of a loose, white quartz sand to great depths. This sand also has an organic hardpan or at least streaks of dark organic matter at or near the water table level if the latter occurs within the sand itself. It may be easily seen from the foregoing that white sands similar to the sands of Puerto Rico are very well known indeed in other parts of the world.

The general processes by which soils of this type are formed are well known. Marbut (6) speaks of the *León* sands as "ground water podzols" and of the *Lakewood* sands as true podzols. Typical podzols or "ashy gray" soils are formed in well drained areas under a humid climate and usually under a conifer forest cover. They are characterized by a surface mulch of semi-decayed organic debris such

as pine needles, leaves, rotten wood, etc.; an ashy gray or nearly white "leached horizon"; a B-horizon or accumulated iron, clay and organic matter and the underlying parent rock. "Ground water podzols", such as the poorly subdrained types of white sands in Puerto Rico, usually occur only where the parent materials are originally very sandy and where the water table is relatively high, or in other words, where subdrainage is very poor. Until quite recently it has been believed by most soil scientists that true podzols can be formed only in a cool temperate region but Marbut (6) has shown that the *Lakewood* sand is a true podzol and it extends well into the warm temperate regions of the south It is significant, however, that only the very leachy sandy soils have thus far been proved to form typical podzols outside of cool temperate regions True podzols derived from heavier materials, have been thought to be confined largely, if not entirely, to humid cool temperate regions, either in high latitudes or at high altitudes in low latitudes Abundant evidence of podzolization in many parts of Puerto Rico from sea level to 3,000 or more feet above the sea, have proved that the process is active here and it is possible that small areas of true podzols from heavier materials than sands may be discovered. A bit of evidence along this line will be discussed later in this paper

Probably much more than half of the white sands of Puerto Rico are "ground water podzols". Hearn (4) in a paper read before the eleventh annual meeting of the American Soil Survey Association, November, 1930, has given a good review of the formation of the *León* type of soil profile, which so closely resembles the ground water podzols of Puerto Rico. He laid special emphasis on the formation of the organic hardpan, which, before analyses were made, was thought to consist of oxides of iron. Briefly, the original material is very sandy and contains only very small percentages of silts and clays. The silts and clays are removed by the downward percolation of meteoric waters. This process is known as "eluviation" and it is aided and hastened by the colloidal organic acids produced by the decay of plant remains. These acids act as solvents for colloidal iron stains which lend ordinary quartz sands a red, yellow or brown coloration, with the ultimate effect of bleaching the sands white. Colloidal organic matter is formed by the work of bacteria which cause the decay of dead roots and leaves of plants in the soil proper. Much of this material is precipitated at the level of ground water forming the organic hardpan. The mass of hardpan is greatly increased by the presence of plant roots which accumulate at the level of ground water. In the southeastern states one of the commonest

plants is the sawtooth palmetto and its roots have been observed to be concentrated in the hardpan. On some of the white sands of Puerto Rico the corozo palm is quite common and it is quite possible that its roots, as well as those of other plants, have contributed to the hardpan.

We may then offer the following suggestions as to the formation of the poorly drained white sands of Puerto Rico. First we start with a soil material which contains a very high to fairly high percentage of silica sands. This sandy soil will lie in a fairly flat position and must either contain an impervious layer beneath or must contain material which may later be used by the soil forming processes to cause conditions of poor drainage. Poor drainage may, of course, also be caused by a high water table which has been brought about by proximity to sea or lake level. There must be some vegetation to furnish organic material to be used by the soil in forming acids, and there must finally be a humid climate to furnish the necessary leaching waters.

In the case of the largest deposits of the sands the original material seems to have been derived partially as a residuum from dissolved slightly arenaceous limestones and partly a subaerial accumulation of sands which have been carried inland from the wave-shattered San Juan sandstone formation. There is some evidence that some of these sands are littoral deposits which have remained after a slight withdrawal of water of the sea and lagoons in recent geological times. It seems almost certain that these larger deposits of sandy materials were locally transported by wind or water or both and deposited on the gray clays of lowlands possibly formerly occupied by lagoons, estuaries or sinkhole ponds. This gray clay furnished the necessary conditions of poor drainage. Vegetation occupied the soil and the leaching of the minor amounts of silts and colloidal materials proceeded at a rapid rate. In many places, typically a short distance southwest of Arecibo, there is a regular transition from highly leached white sands, through gray-brown acid sands to alkaline sands, proceeding toward the seacoast. All of the white sands are far enough from the sea to be almost entirely unaffected by the spray from the breaking waves which are piled up by the trade winds. Soils in this district so affected are universally alkaline in reaction. In such a leaching process any soluble salts disappear first, then the less soluble calcium carbonate and finally, after the decaying organic matter lends an acid condition to the soil, the other soil pigments are dissolved and carried out by the ground water. The poor drainage causes the iron to be reduced to the fer-

rous state which makes it much more soluble. In places where the parent sands contain larger amounts of iron and alumina than normal these materials are mixed with the hardpan

The above description of the formation of white sands covers a very large total area of these soils. Many places having apparent good drainage, if one were to judge by surface appearances, in reality have a fairly high water table which usually lies just above the heavy clay layer It is probable that most or all of the sands of these places should be classed as ground water podzols. There are many other places, however, where subdrainage as well as surface drainage is sufficiently good to throw the white sands into the class of true podzols which form only under normally good drainage conditions. Until very recently it had been considered by most soil scientists that it is very improbable that true podzols would be found in tropical lowlands. Marbut[4] and Affanassief and others have found evidences of podzolization in the tropical lowlands and they have predicted the possibility of the existence of true podzols in this position We are unaware of such podzols having actually been found in tropical lowlands until last year when the white sands of Puerto Rico were thoroughly studied in the field. From a morphological standpoint the well drained white sands which we shall briefly describe below are unquestionably true podzols in the same sense that the *Lakewood* sands of New Jersey are true podzols. We fully expect that chemical analyses will confirm the morphological identification.

If the process of true podzolization is to account for the formation of the well subdrained areas of white sands it would be reasonable to suppose that the same types of deposit might be formed from different materials with different thicknesses of the product and with a large number of gradations between the typical white sands and other soils with which they are associated. One type of such gradation has already been mentioned. In those deposits occurring well within the limestone hills and several miles distant from the seacoast one of the commonest associations of white sands is with a group of soils known provisionally as the *Vega Alta* series. This series of soils has grayish brown surface soils with compact but moderately well drained, coarsely mottled red, yellow and gray subsoils, the former two colors predominating. The heavier types of this series, such as the clay and clay loam are more brown than gray in the surface but the sandier types become grayer with the increase in the percentage of sand present. In many cases the soil surveyor is puzzled as to whether to group these grayer sandier types of soils with

the *Vega Alta* series or with the shallower types of the white sand group. With the graying of the surface horizon there is sometimes a tendency for the subsoil to become more poorly drained. This change in the drainage conditions seems to have been brought about by the eluviation-illuviation process. The clays and colloids have been eluviated from the surface by meteoric waters and deposited in the interstices of the subsoil forming a layer of illuviation. This process slows up drainage and may in many cases ultimately result in the formation of a temporary shallow water table at which an organic hardpan begins to form. This giyes rise to the ultimate formation of the ground water podzol type of white sand. On the other hand there are many places where the subsoil retains sufficiently good drainage to take care of the meteoric waters. One such area lies some distance south of Sabana Hoyo far within the limestone hills in association with soils of the *Vega Alta* series. It has the grayish white surface and white upper subsoil but lacks the organic hardpan. The underlying clay is typical of the *Vega Alta* series of soils and is therefore well drained. The upper subsoil, as in the case of the *Vega Alta* soils, has accumulations of iron and alumina in addition to small amounts of colloidal organic matter. The area occurs on the top of a sharp knoll and is unquestionably a typical sandy podzol. There are several small areas like this one southwest of Arecibo and scattered elsewhere throughout the northern coastal region in association with ground water podzols. Gradations between true podzols and the sandier types of the red *Bayamón* and *Espinosa* soil series are quite common. These red soils also grade into the ground water podzols. The very deep areas of white sands usually are more or less piled up by the trade winds and since they are so loose and dry in their upper horizons it is frequently impossible to determine whether they have water in the lower horizons and whether they have developed organic hardpans. It is altogether probable that part of these deep areas belong to the true sandy podzols and part to the ground water podzols. From the standpoint of agriculture or of commercial use of the sands this problem has no bearing. It is a matter of purely scientific interest.

While we are discussing the sandy podzols it might be of interest to add a further word regarding podzolization in Puerto Rico. A very large total area of soils in the lowlands as well as in the highlands exhibit strong morphological evidences of this process. Many of these areas are of the heavier type of materials such as silts, sandy clays and perhaps clays in places. An extreme example of such soils very recently observed on a low hill near the new pier at Mayagües

is a silt loam with most of the morphological characteristics of a true podzol. We can at least be safe in saying that it is a very strongly podzolized soil. Rainfall is about 80 inches per annum and natural drainage is good. A description in outline form follows. It should be noted that the land has been cleared so that the original leaf mould has been destroyed.

Horizon	Depth	Description
A_1	0″ — 4″	Light brownish gray silt loam when dry. Pale yellowish brown when wet. Medium granular structure.
A_2	4″ — 10″	When dry grayish white; when wet pale yellow floury silt loam. No evident structure.
B	10″ — 30″	Heavy reddish brown and yellowish brown clay containing many tuff and shale fragments. Very stiff when moist. All surfaces of cleavage planes are light gray and silty and gray silt follows root channels.
C	30″ down.	Loose subangular gravels of tuffs, shale and cherty fragments. Possibly an old terrace remnant or elevated beach line.

This area is very small but we believe it to be a significant evidence of the progress of podzolization at low elevations in the tropics. It is of interest to know that this highly podzolized soil occurs within two miles of the largest body of typical ferruginous laterite in Puerto Rico. A number of other places having very similar soils have been observed and it is hoped they may be discussed more fully in a later contribution. We return to the white sands after this short digression.

These white sands in their present position must be considered as very recent deposits from the standpoint of geology. They are certainly younger than the San Juan formation since in no place observed do the San Juan sandstones overlap them. Recent as they are geologically, they are quite old from the soils standpoint. The age of a soil is not measured by the number of years since the weathering forces first started working on its parent material but by the degree of leaching and eluviation which have taken place. An old soil is one in which leaching and eluviation are far advanced. In the case of sands this can take place in a much shorter time than with soils of heavier texture or with those which are high in lime. It is certain that these "old soils" (the white sands) are younger in years than many of the "young soils" of Puerto Rico many of which are so highly valued by the farmers.

It is interesting to notice that there are no white quartz sands west of the Río Guajataca, at least not in the north coastal belt. There are plenty of brown quartz sands which would theoretically be capable of weathering into the white variety but this weathering has not taken place. There is a good reason for this. The rainfall from Camuy to the northwestern corner of the island averages considerably less than 60 inches per annum. A rainfall of 55 inches in Puerto Rico is approximately the dividing line between a humid and a semi-arid climate. Such a rainfall in this part of the tropics might at least be designated as sub-humid. The formation of large areas of white quartz sand requires the leaching effects which can be produced only by a humid climate, hence the disappearing of these deposits in the northwestern part of the island.

A few miles southeast of Humacao large quantities of loose, fine quartz sands and gravels have been washed from nearby quartz-diorite hills and deposited on the sea level estuarine clays of the Río Candelero delta. These very recent deposits have already begun to show signs of leaching under the influence of a heavy rainfall and poor underdrainage. The sands and gravels are changing from brown and yellowish brown to a pale yellowish color. Incipient organic and iron deposits near the level of ground water prognosticate a future development of hardpan similar to that in some of the white sands we have been discussing. The entire island has not yet been covered in detail and it is reasonably possible that very small deposits of white or gray sands somewhat similar to those of the north coast will be found in the humid regions which have not been thoroughly explored.

SUMMARY

The origin of the large deposits of almost pure white quartz sands which occur within the area occupied by the Tertiary limestones of northern Puerto Rico have long been a source of puzzlement to geologists. The largest areas occur within a mile or so of the seacoast in association with Tertiary deposits but are unconformable with them. Many of them are found in association with the remnants of lagoons which were cut off from the sea by the San Juan formation. Some deposits are also in fairly close association with the latter formation in some places. Smaller areas occur well within the limestone hills.

Examinations of limestone outcrops and of residual soils within the limestone hills indicate that a large amount of sand originally came from the solution of layers of impure limestone which formerly

overlay the district. It is altogether probable that some of the sands have been blown inland from the broken up San Juan formation and later leached of their lime. There is some evidence to support the theory that some of these sands may have been left in or near their present position along the shore of former lagoons which have since been drained by a slight emergence of the coast. There is but little question but that the smaller deposits several miles inland and well within the limestone hills are the residuum left from the dissolution of the limestones.

The whiteness and purity of the sands are due to the soil forming process known as podzolization (acid leaching and eluviation) which in this case has taken place largely under conditions of high rainfall and poor subdrainage and to a less extent under well drained conditions. Some of the deeper deposits which are now well drained have been more or less piled up by the winds since they were bleached. We can therefore state with reasonable assurance that the quartz sands have come from the various sources above mentioned but that they are *white* because of a high degree of "podzolic" leaching which has affected them since they accumulated. Millions of acres of similar soils which have been carefully studied by soil scientists in the southeastern United States have furnished the evidence for this explanation of the origin of Puerto Rico's white sand deposits.

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EXPLANATION OF PLATES

PLATE IV

Figure 1. Area of white sand southwest of Arecibo. Vegetation consists of second growth of icaco (*Chrysobalanus icaco* L.) and pajuil or cashew-nut (*Anacardium occidentale* L.) Young cocoanut trees grow very slowly on these infertile sands.

Figure 2. Upper part of profile of white sand. Grayish surface soil slumped into pit at left center. White horizon shows plainly just under plant roots at extreme left.

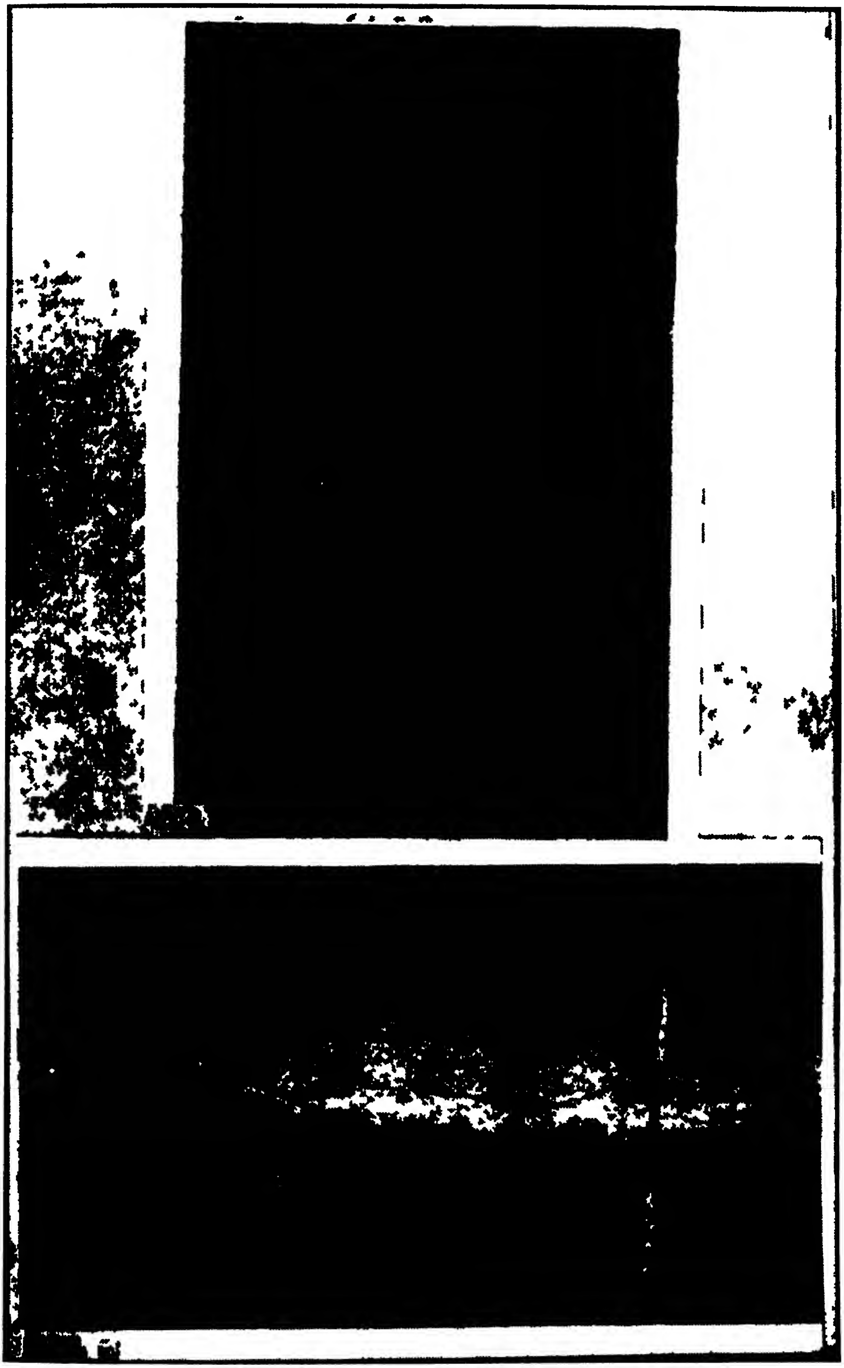
PLATE V

Figure 1. Shows heavy sandy clay which underlies many of the areas of white sands. Light colored vertical and horizontal streaks are white kaolin. Dark colored layer above is organic hardpan.

Figure 2. Highly podzolized soil profile about 4 miles south of Humacao. Soil is derived from quartz diorite and occurs near a hill top. Drainage good. Note strong development of whitish A_2 horizon just above heavy B horizon at center of photograph. Profile similar to the one described from Mayagüez and represents same soil-forming process which caused the formation of the white sands.

PLATE IV.

PLATE V.



PUERTO RICO SEEDLESS ORANGE SELECTIONS

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During the months of August and September, 1928, the senior writer visited the principal fruit-growing districts of Puerto Rico in order to study the varieties of citrus fruits grown and to introduce improved methods for the propagation of selected strains of the commercial citrus fruits. This visit was made in response to an invitation by the Commissioner of Agriculture and Labor of Puerto Rico and with the cooperation of the Bureau of Plant Industry of the U. S. Department of Agriculture. The selection and propagation study of citrus problems was cut short by a severe hurricane that occurred on September 13 and 14 but important information had been obtained before the terrific storm known locally as the San Felipe hurricane, interrupted the investigation. During the search for a superior orange amongst the so-called "wild" or seedling trees an outstanding tree bearing seedless oranges of apparent commercial value was discovered and propagated. This report will contain an account of the discovery and the description of the characteristics of this tree and its fruit and of three others that were found and propagated subsequently.

Discovery of Seedless Orange

Upon his arrival at San Juan, Puerto Rico, in August, 1928, the senior writer met with Hon. C. E. Chardon, then Commissioner of Agriculture and Labor, at his office in the Insular Experiment Station at Río Piedras, in order to decide upon a plan for investigating citrus-bud-selection problems. At this meeting the senior writer proposed amongst other things a systematic search for superior orange trees, particularly amongst the plantings of the so-called "wild" orange trees that are located on various coffee plantations of the hill districts and in the gardens of Puerto Ricans, many of whom have shown a special interest in the planting and study of orange varieties.

During a previous visit to Puerto Rico, in 1905, the senior writer has been impressed by the marked variation in the commercial quality of the Puerto Rican oranges that came under his observation at that time This experience together with a similar one in California citrus orchards during the past twenty-three years were the reasons that led to the proposal of study of the seedling orange trees in Puerto Rico during the Fall of 1928 from the standpoint of determining, so far as possible, the nature of variations, if any, in the trees and their fruits and particularly to look for individual trees that were apparently superior to the average for commercial propagation and culture in Puerto Rico.

A searching party was organized early in September 1928 to carry out a systematic search for a superior orange in certain citrus-growing districts of Puerto Rico. The members of the expedition consisted of Mr. O. W. Barrett, then in charge of farm demonstration work for the Puerto Rico Department of Agriculture and Labor and whose knowledge of local agricultural conditions and familiarity with the Spanish language were valuable in this work, Mr. A Mayoral of the Plant Propagation Station at Trujillo Alto, and the senior writer. The equipment included a supply of sphagnum moss and suitable containers for budsticks in order to insure the proper care for any budwood that might be obtained from any outstanding tree that might be discovered.

Several days were spent in studying orange trees in various locations on the Island but without finding any particularly valuable orange trees of interest from the commercial standpoint. A few selections of budwood from interesting trees that were thought to be better than the average were made but these trees were considered to be of minor commercial importance by the senior writer. While the fruits of these selected trees were apparently superior in one or more commercial characteristics to the average, the fruit and foliage characters did not meet all of the requirements that were considered to be essential for a superior orange variety.

Finally, on September 11th, 1928, a visit was made to a coffee plantation owned by Don Francis Martínez, located in the hill country above the city of Mayagüez and about 1,200 feet above sea level. The orange trees on this plantation, probably more than a thousand in number, were planted for the most part alongside the coffee fields and as a shade for the coffee plants. They were about forty years old, according to the superintendent of the plantation who accompanied us during our study of these trees. They were typical so-called "wild" or mountain orange trees, i. e. apparently seedlings of

the varieties introduced by the Spanish explorers and settlers during the early history of the colonization of Puerto Rico. The principal crop on this plantation was coffee and the maintenance of the orange trees was incidental to the main business of the plantation. In addition to those planted alongside and in the coffee fields, small groups of orange trees were found growing near the houses of the employees as was frequently the case on similar plantations in other districts that were visited during the course of the survey.

At the time of this reconnaissance, the fore part of September 1928, the fruits of most of the orange trees observed were young and small, about the size of walnuts on the average. Now and then a tree was found with larger and more mature oranges while others had only very small fruits. All of the fruits examined from the most promising-looking trees contained several seeds and some of them had as many as 35 or more seeds each. In some instances the rinds were very thin and in others the peels were quite thick. Most of the oranges examined had a tender rag and were very juicy but some of them contained an excessive amount of coarse rag and were lacking in juice. In some instances the flavor of the juice was fair to good but in most cases it was insipid and poor.

Amongst the orange trees in the main border row of the Martínez plantation several apparently interesting ones were examined but upon close study they were found lacking in one or more of the characteristics essential for a superior commercial orange by reason of the undesirable shape, size, rough texture, poor flavor, lateness of maturity, excessive number of seeds or other characters of commercial importance. As a result no attempt was made to collect budwood from any of the trees that were first examined. After walking about half the length of the row, the senior writer noticed in the distance a conspicuous tree that stood out from the neighboring ones so that it attracted his immediate interest. The characteristics of this tree that were particularly noticeable to the senior writer while still some distance from it, included: an unusually large crop of apparently mature oranges having uniformly desirable commercial size and shape, the relatively large size of the tree and its dense, deep green foliage with large, clean, healthy appearing leaves. Instinctively, the senior writer felt at the time that this might be the tree for which he had been searching, but restrained his enthusiasm until it was possible to examine the foliage and the fruits more closely.

Upon reaching the conspicuous tree the senior writer picked an orange nearest at hand and cut it traversely across the mid section. The first glance at the cross section showed that the orange has a

medium thickness of peel, the flesh was firm and had an attractive texture and color, the core was very small and solid and no seeds were visible. Small sections were immediately cut from the two halves and handed to members of the party. After tasting these samples everyone present agreed that the flavor of the juice, texture of the flesh, and the bouquet or aroma of this fruit was superior to any of the samples tasted heretofore on this trip or to the best of their recollection in any previous tests. The fruit was found to be entirely without seed or any evidence of seediness. The senior writer then cut, in a similar manner, 24 other oranges that were picked from different branches of this tree and every one without exception proved to have very similar characteristics to those of the first one examined, including absence of seeds, firm and very tender flesh, no apparent core, an abundance of excellent flavored juice, medium thicknesss of rind and exceptionally desirable size and shape of orange from the commercial standpoint. The unanimous opinion of those present was that this was the best eating orange that they had tasted to the best of their recollection.

About 50 budsticks were then cut from this outstanding tree, each with one or more typical fruits attached. The fruits were cut off from the budsticks and their characteristics noted, particularly the absence of seeds. The budwood was carefully labelled and immediately packed in moist sphagnum moss. A few additional oranges were also picked from the tree for subsequent examination.

The remaining orange trees in the row were looked over before the party left the plantation but nothing of particular interest was observed. By this time darkness precluded any further field studies and the party returned to Mayagüez for the night. On the morning of September 12, 1928, a visit was made to several Mayagüez gardens and the party started on their return trip to San Juan. En route a stop was made at San Sebastián where several small garden orange plantings were looked over. One of the growers reported an orange tree located on his coffee plantation some distance from the city that produced characteristically seedless and desirable fruits. Arrangements were made to visit this planting subsequently in order to obtain further data and budwood for possible propagation but owing to circumstances the senior writer was unable to carry out this plan.

While at San Sebastián during the afternoon of September 12th one of the growers mentioned the fact that a hurricane had been reported from the Virgin Islands and that it was apparently approaching Puerto Rico. Accordingly haste was made to return to San Juan, but a short stop was made at Garrochales in order to visit one

of the larger Grape Fruit orchards. While at Garrochales showers began to fall and the southwestern sky developed a leaden or coppery appearance that indicated, according to the experienced members of the party, the approach of a hurricane. San Juan was reached late in the evening of September 12th and about midnight the hurricane arrived, the first stages of which consisted of terrific gusts of wind that were accompanied by a torrential downpour. On the following day the hurricane persisted until about five o'clock when a calm period occurred. Later, about nine o'clock in the evening, the wind began to blow again with hurricane violence, tho not so strongly as during the first phase of the storm, and continued until about eight o'clock of the morning of September 14th. On the following day, September 15th, the buds from the outstanding Martínez Orange tree were inserted in seedling rootstocks in propagating grounds and nursery located at Trujillo Alto, near San Juan. The leaves of the young rootstocks had been badly whipped by the violent windstorm but the seedlings were still in fairly satisfactory condition for budding on account of the fact that they were located in a sheltered place. The young nursery trees resulting from this propagation were eventually distributed in the model farms and to growers for tests of the new variety for commercial orange production.

On account of the widespread damage to Agriculture as a result of the terrific hurricane further study of the native orange trees were abandoned for the time being and the senior writer returned to Washington, D. C. However, before leaving, the senior writer drew up a systematic plan for a study of these trees and when conditions became settled after the disaster further search was made for outstanding trees. Three additional selections have been made during recent years and descriptions of these outstanding trees and samples of fruits from them are included in this report.

In January, 1931, Edmund H. Twight, of Riverside, California, the junior author, was appointed Specialist in Fruits for the Insular Experiment Station by the Puerto Rico Department of Agriculture and Commerce. He has been instrumental in bringing together the other three Rico oranges and in collecting much of the data contained in this paper. On January 8, 1932, the senior author received at Riverside, samples of the four Rico oranges from the junior author. They were picked from the selected parent trees as noted in the description. Those fruits under California quarantine regulations were shipped to Riverside from Puerto Rico in care of the Riverside County Agricultural Commissioner, in whose office they

were examined and photographed after which they were carefully burned in order to eliminate any possibility of the introduction of insect pests or disease. In addition to the personal studies of these oranges, the senior writer obtained the services of three of the leading orange growers and packers in the Riverside district in order to secure their opinions as to the commercial value of each sample and particularly their judgment as to the most desirable one of the four varieties for a commercial orchard test. Fortunately the Agricultural Commissioners of the Southern California Counties were meeting where these fruits were examined and their opinions as to the fruit characteristics and their apparent commercial value were also obtained.

The circumference and weight of each orange in all of the samples were recorded, systematic notes were made as to the color, thickness and texture of the rinds, shape of the fruit, color of flesh, character of the rag, the amount and color and flavor of the juice, the size and nature of the core, the number of segments in a typical fruit of each sample, the number of seeds, if any, the presence or absence of a navel and the soluble solids-acid ratio of the juice of a composite sample made up from three oranges of each lot were recorded. Photographs of each sample of fruits were made but owing to the poor lighting conditions in the room where the photographing was done the resulting pictures are not as clear as would have been under more favorable conditions. Each sample was examined by all those present during these tests by tasting and thru systematic inspections of the inner and outer characteristics of the fruits. Ample time was available so that opportunity was given to study the oranges adequately and to consider their characteristics from different points of view.

Some of the outstanding characteristics of the samples of oranges were: the absence of seeds, their desirable shape, size and texture from the commercial point of view, the fine bouquet and flavor of the juice, the small amount and melting character of the rag, and the good outside color of the oranges even though they had not been washed or treated in any way in order to improve their appearance. Some smut from scale was found on most of the fruits but that could have been easily washed off. Treatment with Ethylene gas would doubtless have improved their color from the commercial standpoint, but at that time it was considered best to photograph and record the descriptive notes without any cleaning or other fruit treatment.

The writers know of only one commercial orange variety, the trees of which characteristically bear seedless fruits in the South-

west, the Washington Navel Orange, which is one of the most important orange varieties grown. For this reason, if for no other, the orange selections described in this report are of scientific interest and one or more of them are likely to be commercially important. The particularly attractive flavor and bouquet of the abundant juice, the melting and very tender nature of the small amount of rag and the desirable commercial sizes and shapes of the fruits makes them of more than ordinary interest.

Following are the descriptive notes obtained from the examination of the fruits of the Puerto Rico orange selections that were sent to the senior writer from Puerto Rico by the junior author of this report. In addition to the data obtained from a study of the samples of fruit, notes are presented that give the facts concerning the location, discovery and propagation of each parent tree together with the description of some of the most important parent tree characteristics from data obtained largely by the junior author in the course of his official duties in Puerto Rico during the season of 1931.

The parent-tree selections have been given temporary names and numbers in order to identify them, the first one found being called Rico No. 1, the second Rico No. 2, and the other two Rico No. 5 and Rico No. 6. No fruits have been produced by the progeny trees as yet but their foliage indicates that the characteristics of the parent trees have been probably perpetuated through bud propagation.

Location and Characteristics of the Rico No. 1

This tree is located on the mountain coffee plantation owned by Don Francisco Martínez in the Mayagüez district of Puerto Rico at an elevation of about 1,200 feet above sea level. The soil on this plantation is red clay. The tree was discovered by A. D. Shamel on September 11, 1928, and the first progeny propagation was made on September 15, 1928, at Trujillo Alto in the nursery of the Plant Propagation Station. The nursery progeny was subsequently planted at the Propagation Station, the Insular Experiment Station, the various Model Farms and the Orchard of Hill Bros. at Sabana Llana. The young progeny tree had some fruit this year (1932) but the San Ciprián hurricane of September 26 (1932) shook them off; the trees, however, were not damaged. The parent tree is about forty years old, about 30 feet high, has a spread of about 30 feet, the diameter of the tree three feet from ground is about 12 inches. As the result of the hurricane of September 1928, the heavily laden tree was seriously injured and is now in very poor condition altho at the time of its discovery it was very vigorous. The habit of growth

of this parent tree is erect, the yield for 1932 was estimated at from 3 to 4 cases of oranges, the uniformity of the fruit is good and the commercial quality of the oranges is excellent. The tree is located on a shady mountain slope, one in a row of oranges that form a border for the adjacent coffee plantation.

DESCRIPTION OF SAMPLES OF RICO ORANGE No 1

Individual Orange Number	Weight Ounces	Circumference Inches
1	11½	10 10/16
2	11½	10 7/16
3	11	10 7/16
4	10	9 13/16
5	9	9 11/16
6	8½	9 9/16
7	8	9 4/16
8	8	9 3/16
9	8	9 3/16
Average	9 5	9 81

The color of the rinds of the fruits is deep yellow with a reddish tinge, the texture is smooth; the shape of the fruit is slightly obovoid, the peel is about 3/16 of an inch thick, the flesh is firm, has a deep yellow color, exceptionally small amount of tender rag and excellent eating quality; the juice is abundant, 3 oranges producing about one pint; the color of the juice is yellow and more attractive than that of the other samples of Rico oranges examined, the flavor is excellent, eleven segments in one orange; small solid core; no seeds; no navel; soluble solid-acid ratio 11.8 to 1.

Location and Characteristics of the Rico No 2

The parent tree Rico No. 2 was located by Julio S. Simons, Superintendent of the San Sebastián Demonstration Farm during 1930 on the mountain coffee plantation owned by Don Francisco Roig in Barrio Perchos between San Sebastián and Lares, about one and half hour on horse back from the highway. The tree is located about 2,000 feet above sea level. The soil is a heavy reddish clay. The first progeny propagation of this tree was made by A. Mayoral at the San Sebastián demonstration farm and at the Plant Propagation Station of Trujillo Alto on February 15, 1930, and another was made in June, 1931, by E. H. Twight. The resulting nursery progeny trees were planted subsequently at the Plant Propagation Station of Trujillo Alto and at the San Sebastián Model Farm.

This parent tree is about 40 years old, has a height of about 30 feet and a spread of about 30 feet. The diameter of the trunk three feet above the ground is about 12 inches. The vigor of vegetative

growth is good and the crop for 1932 is estimated to be from 3 to 4 cases The fruit is fairly uniform with the exception of that on the céntral growth. The tree has an erect habit of growth. It is growing on a steep hillside and in partial shade.

DESCRIPTION OF SAMPLES OF RICO ORANGE No 2*

Individual Orange Number	Weight Ounces	Circumference Inches
1	12	10 6/16
2	11	10 4/16
3	11	10 4/16
4	10	10 8/16
5	10	9 15/16
Average	10 8	10 23

* 3 oranges badly effected with brown rot decay, not included

The color of the rinds is deep yellow tinged with red, the texture is smooth; the shape of fruit is obovoid; the peel is 3/16 of an inch in thickness; the flesh is firm, has a deep yellow color, tender rag and good eating qualities, the juice abundant, 3 oranges producing a little less than a pint of juice and has a fine distinctive flavor, the core is small and solid; 9 segments in one fruit; small rudimentary navels in rinds at blossom ends of the fruit with very small navel opening or practically closed; no seeds, soluble solid-acid ratio: 14.5 to 1.

Location and Characteristics of the Rico No. 5

This tree is located on the mountain coffee plantation owned by Don Ignacio Roig near Guayanilla in the southwestern part of the Island and about two hours by horseback from the highway (Kilometer 241) at an elevation of about 2,000 feet above sea level. The soil is a heavy clay loam. This parent tree was located by Félix A. Velasco, Agricultural Agent at Guayanilla, in the Fall of 1930. As in the case of the Rico No 2 and of the Rico No. 6 parent trees, the owner had known for years that this particular tree was prolific and produced each year crops of commercially desirable and seedless oranges Progeny propagation of this parent tree was first made during the Spring and Fall of 1931 at the Insular Station at Río Piedras and at the Plant Propagation Station at Trujillo Alto by the junior author, and again in 1932.

The parent tree is about 40 years old, about 30 feet high and has a spread of about twenty-five feet. The diameter of the trunk three feet above ground is ten inches. The vigor of vegetative growth is good and the yield of fruit is about 3 cases annually. The fruit is

uniformly good. The tree has an upright habit of growth but leans to the northwest on account of prevailing winds. It is located on a steep mountain slope and stands on a ledge that overhangs a dashing mountain stream.

DESCRIPTION OF SAMPLES OF RICO ORANGE No 5

Individual Orange Number	Weight Ounces	Circumference Inches
1 ..	15	11 14/16
2	14	11 10/16
3 ...	13	11 6/16
4	13	11 1/16
5	12½	10 13/16
6	12	10 15/16
7	12	10 13/16
8	9	9 15/16
Average	12 5	11 06

The color of the rind is light yellow, the texture somewhat coarse; the shape of the fruit is slightly obovoid but more spherical than in the case with the other samples; the peel is about 4/16 inch thick; the flesh has a deep yellow color and the rag tender; the juice abundant and has a good color; 3 oranges produced one pint of juice; the core is open and about 10/16 inch in diameter; ten segments in one fruit; one large imperfect seed was found in 5 fruits; no navels; the soluble solid-acid ratio: 12.5 to 1.

Location and Characteristics of the Rico No. 6

The parent tree of the Rico No. 6 is located on the mountain coffee plantation owned by Don Carmelo Albino Bisot near Sabana Grande and about two hours by horse back from Sabana Grande. The soil is a heavy reddish clay with a shallow covering of black loam. The tree stands at an elevation of about 2,000 feet above sea level.

It was located by Félix A Velasco, Agricultural Agent, Guayanilla, and was propagated at the Insular Experiment Station at Río Piedras in March, 1931 The resulting progeny trees were planted at the Plant Propagation Station at Trujillo Alto in April, 1932, by the junior author The parent tree is about forty years old, thirty feet high and has a spread of about thirty feet. The trunk diameter three feet above ground is about 12 inches The vigor of vegetative growth is good, the production fair and the fruits are fairly uniform. The habit of tree growth is erect and the tree is growing on a shady mountain slope. As with the other selected parent trees, Rico No. 1, Rico No. 2 and Rico No. 5, no pruning, cultivation, spraying, soil fertilization or other care has been given this tree.

DESCRIPTION OF SAMPLES OF RICO ORANGE No 6

Individual Orange Number	Weight Ounces	Circumference Inches
1	11½	10 13/16
2	10	10 6/16
3	9½	9 12/16
4	9	9 11/16
5	9	9 7/16
6	9	9 [illegible]/16
7 Very flat	7½	9 6/16

The color of the rind of fruit is deep yellow tinged with red and the texture is smooth, the shape of the fruits is somewhat flattened as with the Marsh Grape fruit, the peel is about 4/16 of an inch thick, the flesh is deep yellow in color and has a tender rag; the juice is abundant and of exceptionally fine flavor, three and one-half oranges produced a pint of juice, 4 fruits had a total of four perfect and two imperfect seeds and two fruits were seedless, no navel; soluble solid-acid ratio: 12 to 1

Explanation of Plates

Plate VI. Typical fruits from seedless orange selection Rico No. 1. Original tree near Mayaguez, Puerto Rico

Plate VII. Typical fruits from seedless navel orange selection Rico No. 2 Ranch of Mr Roig, San Sebastián, Puerto Rico.

Plate VIII. Typical fruits from seedless orange selection Rico No. 5.

Plate IX Typical fruits of seedless orange selection Rico No 6 Sabana Grande

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PLATE VI.

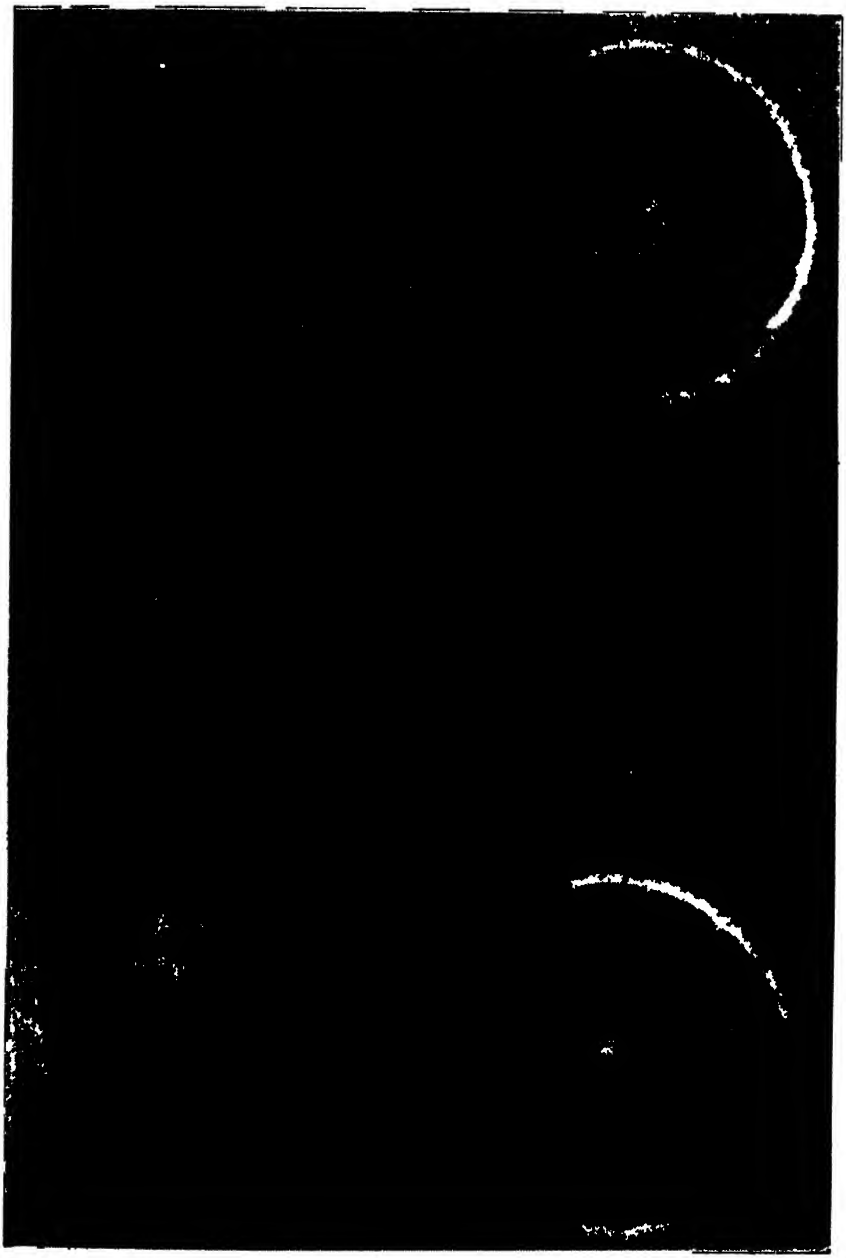

PLATE VII.

PLATE VIII.

PLATE IX.

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ANASTREPHA (TRYPETYDAE, DIPTERA) FRUIT FLIES IN PUERTO RICO

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Two species of fruit flies of the genus *Anastrepha* occur in the Island of Puerto Rico. In this region, they can be conveniently differentiated on the basis of the host selection, that is, the fruits in which the maggots are found, although in the case of two of the host fruits, both species may be found together. The two species can unquestionably be differentiated in the egg and adult stages. In the larval stage, the one character used to distinguish them seems to be constant. One is described as a distinct new species: *unipuncta*. The other, although differing greatly in host fruits from the species *fraterculus* as reported from some localities in South America, is here considered as a variety of that species: *mombinpraeoptans* because of its preference for the hog plum, (*Spondias mombin* L.). The lack of more data from South America does not seem to justify a greater differentiation at present.

What has previously been called the West Indian fruit fly, *Anastrepha fraterculus,* was described by Wiedemann (10) in 1830 from a Brazilian specimen and was first reported from Puerto Rico by Gundlach (4) in 1887 as *Acrotoxa fraterculus* and *Trypeta fraterculus* Wied., in synonymy as determined by Roeder. Up to recently it was considered the only species of *Anastrepha* on the Island.

In 1911, after the Puerto Rico Experiment Station at Mayagüez had introduced some of the selected East Indian varieties of mangoes it was noticed that some, especially the Cambodiana, were attacked by fruit flies, and in that same year, Tower (9) published an account of the life history of the insect under the name of *Anastrepha acidusa* Walker, as determined by W. R. Walton.

In 1912, Dr. Hooker (5) also of the Puerto Rico Station reported that a comparison made by Dr. L. O. Howard with the type of *A. acidusa* in the British Museum showed the fruit fly from Puerto Rico (it is not possible to tell which of the two) to be a different species, possibly undescribed. In the same report, however, it is added that

Prof. Bezzi identified specimens as *A. fraterculus* and that Mr. Knab was inclined also to consider them as belonging to that species.

In Dr. Wolcott's check list of the insects of Puerto Rico (11) published in 1923, *A. fraterculus* is the only species recorded, and *A. acidusa* is given as a synonym. The host plants of the two species are given as those of the single species recognized at the time.

In 1925, at a hearing (7) held in Washington, D. C., to consider prohibiting or restricting the entrance of citrus fruits from Puerto Rico into the United States due to the presence of *A. fraterculus,* Dr. C. L. Marlatt expressed the opinion that although *A. fraterculus* did not infest citrus fruits in Puerto Rico, *Anastrepha* larvae had been found on one occasion in citrus from the Isle of Pines and furthermore stated that:

> "In our examination of citrus fruits from the West Indies and Mexico, Central America, etc., we find that these native fruit flies which occur throughout all that region do not attack citrus. It is not at all impossible that there may be a rare case of a maggot of these other fruit flies coming in citrus fruit. The insect may lay eggs under some abnormal conditions in citrus fruit and there is a possibility of course that infestation may result."

Since this hearing, the exportation of citrus fruits from Puerto Rico into the United States has continued uninterruptedly, the shipments being accompanied by permits issued by Inspectors of the Bureau of Plant Quarantine stationed on the Island. The permits are based on inspections made throughout the year in the groves and again in the packing houses before shipment. The inspections are most carefully conducted during the spring and summer and since 1931, with special care in the localities where infestations might be considered more likely to occur. As stated by Dr. G. G. Becker in the report on his trip of inspection to Puerto Rico, May 28 to June 13, 1931:

> "A much greater fruit-fly risk is assumed in shipments of Cuban and Isle of Pines citrus than is assumed with Puerto Rican citrus because of the fact that fruit from the former Islands is given only a cursory examination on arrival."

In April, 1926, Mr. José Luciano of the Insular Quarantine Service found one fruit-fly larva in a native sweet orange (grown most likely in the western part of the Island) which was identified by Mr. C. T. Greene as *Anastrepha* sp. In the spring and summer of 1931 some infested grapefruit, sour oranges and one native sweet orange were found in the western part of the Island and a few infested Valencia oranges in two trees in a large commercial grove in the northern

part. In April 15, 1932, a few infested grapefruits and some sour oranges (very remarkably in the same grove and practically on the same date as the previous year), were again found in the west and a few infested sour oranges were also found in one locality in the south. Those infestations, as shown by careful surveys conducted by inspectors of the Bureau of Plant Quarantine and the Insular Quarantine Service in cooperation, have all been localized, of short duration and involving only an infinitesimal number of fruits compared with the total crop of the Island. Nothing can be added at present to the statements made by Dr. Marlatt to explain why those infestations take place. They do not occur when the flies are more abundant and neither do they seem to be caused simply by a lack or scarcity of their ordinary host fruits. They might possibly be due to a special activity of some of the flies in the spring and summer, or to a certain tendency of some individuals. Whatever the cause, and even though the host plants of the insect occur in the neighborhood of practically all the citrus groves in the Island without infestation taking place, the elimination of those host plants would eliminate the source of flies in the vicinity of the groves and therefore also the danger of infestation. Picking the fruit early would also reduce the danger since the infestations have been found in the spring and at the beginning of summer. The fly that has been reared from citrus fruits in Puerto Rico is *not* the one that breeds in mango, "jobo", and "ciruela" but another distinct species which breeds commonly in guava, rose apple, to some extent in tropical almond and less commonly in custard apple, star apple, zapodilla, beach plum and kunquat.

So much confusion exists as to what are the characters of *Anastrepha fraterculus* Wied., that it would seem desirable to describe what has been considered to be that species in Puerto Rico as new. But due to lack of sufficient reared material and data on the immature stages from a large number of localities throughout its wide range in the West Indies, Central and South America, for the present, the insect as found in Puerto Rico is here redescribed as a variety within the species *fraterculus*. Several such varieties may eventually be established and some may prove to be distinct species. The creation of varietal names will facilitate the study of the genus *Anastrepha* and particularly the species *fraterculus*. It may be useful also in connection with quarantine regulations. A long list of plants has been reported infested by *A. fraterculus*, but in some localities where *A. fraterculus* is reported to occur, some of those plants are not infested. Manifestedly, one locality should not be put under

quarantine regulations on the basis of the plants the insect attacks in another. The reason why some plants are infested in one locality and not in another may most readily be explained perhaps, by the existence of varieties within the species *fraterculus*. It is possible also that in some localities, plants reported infested by *A. fraterculus* may have been infested, as in Puerto Rico, by some other closely related species heretofore confused with it.

On this basis it would appear desirable to retain the common name of West Indian fruit fly, restricting it to the mango and jobo infesting variety: *mombinpraeoptans*, which does not attack citrus in Puerto Rico. This variety is probably found in other West Indian islands besides Puerto Rico, and presumably also in tropical Central and South America. For the variety (if we may consider it as such) of *A. fraterculus* which attacks citrus and subtropical fruits in Brazil, Argentina and other South American countries, the common name of South American fruit fly as used by Essig (2) would be appropriate. Essig, when using that term in his book, was not considering varieties.

In describing the adult, the three bands on the wings (Fig. 60) are given names. The basal band extends from the base of the wing along the costal border to the end of the apical cell. The S-shaped band is clearly marked from the tip of the wing along the anterior margin to about the middle, thence bending over the radio-medial cross-vein it reaches the tip of the anal cell diffusing over it towards the base of the wing. The two arms of the inverted V-band rest on the posterior margin. Because there is no connection between them, the basal and the S-shaped bands stand out very clearly in figures 2 and 60. In figure 3 (*A. fraterculus* from Argentine), there being no connection between the S-band and the inverted V-band, the shape of the latter is quite striking. In describing wings such as shown in figures 2 and 3, the three bands immediately catch the eye. In figure 1, however, because of the connections, the three-banded effect is somewhat lost. Although *A. fraterculus* in Argentine is not discussed in detail in this paper, an illustration of the wing has been introduced for comparison.

In obtaining the eggs of the two species, it has been found convenient to take advantage of the fact that the females when kept for a time in cages without fruits in which to oviposit, seem to be in such a hurry when suitable fruits are made available, that they deposit the first eggs on the surface of the fruits as they run over them trailing the ovipositor. The normal shape and size of the eggs can be more easily observed in such than in eggs dissected out of

the flies or out of the fruits. In the variety *mombinpraeoptans* the tips of the eggs protruding out of the cuticle of the fruits makes the search for them a simple operation, but unless the spot where the females insert the ovipositor in fruits in cages is marked, it is quite difficult to locate those of *A. unipuncta,* which are deposited entirely under the cuticle.

WIEDEMANN'S DESCRIPTION OF **A. fraterculus**

"Flavus; alis dimidio basilari costae, plaga S formi, fascia dimidia lineaque apicis obliqua flavis. Yellow, wing with basal half of rib yellow, "S" formed mark, half a hyphen and line at apex.

"Length 2⅗ lines. From Brazil.

"This species is much similar to *D. parallelus,* only it is much smaller, the costal stripe and the band and the line, which correspond to the third stripe of that one, are different. Antennae medium length, bristle not plumose. Color very pale rust yellowish; face the same, frons somewhat deeper yellow. Entire back (thorax) of a pale yellow in between acorn-brown to 'Izabell yellow',— this perhaps lost of its purity through smears with arsenic solution. Abdomen fuller yellow, sides of thorax and legs leather-yellow. Abdomen incisions (postorior edge of segments whitish. Bristles and hair of head and body black. Base of wing from the costa to the third longitudinal vein deep yellow, in the radial cell lighter. From the inner hind margin, near the base of the wing, an oblique "S" mark runs over the middle cross vein with its first bend reaching the costa, (whereby there is left a triangular hyaline space between it and the basal stripe), then with a sharp bending along the outer wing margin to below the end of the third longitudinal vein. From the hind edge of the wing there is a hyphen (band) spreading over the ordinary cross vein and reaching to about the middle of the wing width; from the hind margin of the wing apex a tapering line extends obliquely and reaches over the end of the band, but in no way connected with the same. Band and line are slightly brown. In my collection."

Anastrepha fraterculus Wied., var. **mombinpraeoptans,** new variety.

The adult: Maximum size, male 7 mm., female (Fig. 4) with ovipositor, 8 mm., ovipositor, 1.8 mm. Wing expanse, 14 to 15 mm.(1) Head yellow, face light lemon yellow, front a grayish yellow amber. Compound eyes metallic irridescent. An almost black bloch between the simple eyes. Antennae with slight reddish tinge, arista chestnut. Proboscis golden yellow, palpi with very slight reddish tinge. Thorax dorsally reddish brown (2) with dark chestnut or blackish pile (3);

(1) In Wiedemann's description the size is given as 2⅗ lines. In Pierce's manual it is 12 mm., exclusive of the ovipositor with a wing expanse slightly over 25 mm. In Argentina according to Rust (8) average sizes are for the male 7 to 8 mm, with a wing expanse of 15 to 16 mm., and for the female 10 to 11 mm, with the ovipositor, ovipositor 2 mm. and wing expanse 18 to 20 mm.

(2) According to Wiedemann: "the entire back (thorax) is of a pale yellow in between acorn-brown and Isabell-yellow, this perhaps lost of its purity through smears with arsenic solution."

median mesoscutal vitta sulphur yellow with whitish pile([3]), linear from collar expanding posteriorly into a cuneiform shape not reaching scutellum (Fig. 37); scutellum and lateral mesoscutal vitta sulphur yellow with scanty blackish pile. Metanotum a reddish amber with or without two markings which may be light or dark, shaped as spots or larger blotches Side of thorax dull yellow, pleural vitta enamelled sulphur yellow. An almost black rounded spot behind the wing base([4]). The usual bristles all black. Abdomen amber with blackish pile and black bristles, posterior edges of segments usually showing as three lighter transverse bands. Ovipositor reddish amber, darker than abdomen, dorsally with an almost black spot near the tip. Two rounded, almost black spots on the membrane at the base of the ovopositor([4]).

Legs lighter yellow than body, tibiae and tarsi, slightly tinged with reddish.

Wings (Fig. 1) hyaline, iridescent, markings in the shape of three brownish orange bands overlaid in part with a smoky brown which in places is blackish. The borders of the bands darker in places. Occasional vacuoles or lightly pigmented areas in the bands. Basal band brownish orange from the base of the wing to apical cell. Apical cell darker. S-shaped band dark smoky from tip of wing along anterior margin to about the middle, thence dark brownish orange over the radiomedial cross-vein and lighter brownish orange over it into cell 1st M_2. On cell Cu_1 there are usually two dark spots, sometimes coalescing, one of which is on the tip of the anal cell([5]). The basal and the S bands are connected at a point near the r-m cross-vein thus leaving a triangular or notch shaped hyaline area between them with its base on the anterior margin and the apex pointing towards the posterior margin of the wing. Inverted V band with its arms resting on the posterior margin, the vertex connecting with the S band, the connection usually strong([6]), the vertex is brownish orange, the arms smoky. Very exceptionally (Fig. 55) the arms of the inverted V band may be disconnected as described by Wiedemann. In one specimen the S band was found to be cut in two at the middle, (Fig. 56). Figures 43 to 56 show some only of the more striking variations that occur in the *mombinpraeoptans* variety.

Described from 3,000 freshly killed specimens reared by the writer from the different fruits in which the insect breeds in Puerto Rico during the years 1927 to 1933 from many localities both in the costal plain and the higher elevations. Dried specimens in the collections of the Insular and Puerto Rico Experiment Stations and in the National Museum in Washington, D. C., some of them collected as far back as 1913 and identified as *A. fraterculus* have also been examined. Dried specimens are brownish with the vittae whitish.

Type.—A single female; (P. R. Ac. No. 44–33), March 20, 1933, Río Piedras, Puerto Rico; reared by F. Seín, Jr., from *Spondias mombin* L. In the U. S. National Museum, Washington, D. C.

Paratypes.—Four female specimens; (P. R. Ac. No. 44–33), March 20, 1933,

([3]) In Wiedemann's description the bristles and hairs of head and body are black, but according to Loew (6) the pile on Wiedemann's type was light chestnut or yellowish. Dr. C. H. Curran has informed the writer that *fraterculus* has the abdomen wholly yellow haired and has yellow or brownish bristles.

([4]) Not mentioned in former descriptions of *fraterculus*.

([5]) According to Bezzi (1) this spot is not present in *fraterculus*. Greene (3) who states that the adults are easily differentiated on wing pattern illustrates the spot for *A. fraterculus* but not for *A. ludens* or *A. serpentina* and indistinct for *A. striata*.

([6]) In Wiedemann's description the arms are "in no way connected". Loew states that in Wiedemann's type the connection was present though not very distinct.

Río Piedras, Puerto Rico, reared by F. Seín, Jr., from *Spondias mombin* L. In the British Museum, London, England, and at the Insular Experiment Station, Río Piedras, Puerto Rico.

Mounted wings from which the drawings of the variations in pattern and slides from which the drawings of the posterior spiracles and the hairs or rays were made deposited at the Insular Experiment Station.

The egg: Length, 1.4 mm.; Width, 0.4 mm.; Spindle shaped with one end prolonged into a neck which usually swells somewhat into an ovoid head at its extremity, the other end bluntly pointed, (Figs. 8, 9 and 10). Egg membrane white, opaque, smooth and glossy. The egg is inserted in the fruit up to the shoulder, the head and neck protruding outside of the cuticle (Figs. 6–8 and 10). The larva emerges through a slit near the pointed end.

Described from eggs dissected out of fruits, from mature eggs dissected out of the female flies and from eggs deposited on the surface of fruits in cages.

The larva: Maximum length, 10 mm., width, 2 mm., at posterior end; cylindrical, tapering slightly towards cephalic end When young, cream colored, usually turning later to a golden yellow. In addition to the head region, the body consists of 11 segments of about equal length; a ventral fusiform area on anterior portion of each of segments 2 or 3 to 11(7), (Fig. 16). Head, (Fig. 14), small, partly retractile, each side of the front bearing two broadly rounded somewhat flattened tubercles, the antennae(8) slightly larger; mouth hooks (Figs. 20–25), medium sized, first part rather slender, first and second parts black, second part shaped more frequently like the head of a hammer(9), third part with a dark brown infuscated area at base which fades to hyaline towards apices. Anterior spiracles small, yellowish, chitinized, with from 10 to 16 small rounded tubules(10) arranged in an irregular row, (Fig. 15). Posterior spiracles, (Figs. 17, 19 and 27), medium sized, each spiracle with three broad yellow entrances, each with a dark brown peritreme, entrances more frequently arranged so that the two above are parallel and the one below obliquely upturned(11), Figs. 17 and 19), but in some specimens all three entrances may converge, (Fig. 27). In some specimens the entrances may be described as short and thick, in others as longer and more slender. Hairs (rays) branched and well spaced as shown in (Fig. 17). Button large but indistinct. Above each spiracle two small tubercles in a transverse line and below, two small tubercles slightly wider apart and almost in a transverse line (12), (Fig. 26). The lower pair of tubercles is in some specimens located in a ridge, (Fig. 26, *a* and *b*), in others in two ridges (Fig. 26, *c* and *d*), and the innermost of the two tubercles is usually bifid (Fig. 26, *a* and *c*). Another pair of tubercles can usually be seen on the median line between the upper and the lower pair(14). Anal elevation large, rounded and with two prominent lobes.

(7) According to Greene (3) in *A. fraterculus* the fusiform area occurs on segments 4 to 11.

(8) Greene illustrates a somewhat differently shaped antenna.

(9) Greene's illustration shows it shaped somewhat like a bottle.

(10) According to Greene *A. fraterculus* has from 15 to 17 tubules, *A. striata* and *A. serpentina* go as high as 17 and *C. capitata* as low as 10.

(11) According to Greene the second is the only arrangement that occurs in *fraterculus*.

(12) According to Greene there is one tubercule below each spiracle.

(13) Greene does not consider them as bifid; this condition was first pointed out to the writer by Mr. F. H. Benjamin.

(14) Not mentioned by Greene.

Described from 500 full grown larvae from the same sources as the adults.

The puparium: Maximum length, 5.7 mm., width, 2 to 2.4 mm., cylindrical, yellowish, later turning to mahogany; 11 distinct segments, (Figs. 32–35). Anterior spiracles like those of the larva but darker and somewhat shrunk. Posterior spiracles (Fig. 36) medium sized, dark reddish, located in a faintly depressed area somewhat oval in shape, a broad flattened projection extending down between the upper end of the spiracular plates([18]), each spiracle with three broad yellow entrances, each located on a well defined ridge; button small and indistinct. Anal plate large, dark and round.

Described from 500 specimens from the same source as the larva. Material from Panama (whence Greene drew his description) has also been examined.

Hosts: Hog plum, "jobo" *Spondias mombin* L.; "ciruela", *S. cirouella* Tussac and *S. purpurea* L., some mango varieties, *Mangifera indica* L., and rarely in "jobo de la India", *S. dulcis* Frost. Occasionally some may breed in guava, "guayaba", *Psidium guajava* L., and rose apple, "pomarrosa", *Jambos jambos* L.

Anastrepha unipuncta new species

The adults of this species can readily be differentiated from *A. fraterculus* Wied., var. *mombinpraeoptans* by the dark spot on the suture between the metathorax and the scutellum. The egg has no neck and is deposited entirely underneath the cuticle of the fruit. The larva has the hairs or rays in the posterior spiracles more numerous, closer together and somewhat less branched. No character has yet been found to distinguish the puparium. An occasional puparium may be formed inside the fruits in which the larvae have developed, a habit which has not been observed in *A. fraterculus* Wied., var. *mombinpraeoptans*.

The adult: Slightly darker than *A. fraterculus* Wied., var. *mombinpraeoptans* and similar in size; ovipositor very slightly longer and wider at the middle, (Fig. 42). Thorax (Fig. 5) dorsally a reddish amber or honey color the median mesoscutal vitta linear and faintly lighter than thorax; lateral and pleural vittae a dull greenish yellow. Pile on dorsal part of thorax all blackish (Fig. 38). A noticeable dark spot on the suture between the metathorax and the scutellum, (Figs. 5, 38 and 39) invariably present. Wing markings (Figs. 2 and 57–60), usually darker and more smoky and in some individuals different in pattern from *A. fraterculus* Wied., var. *mombinpraeoptans*. Basal band dark smoky. S shaped band dark smoky to near the r-m cross vein thence brownish yellow to cell Cu_1. In cell Cu_1 the two dark smoky spots frequently coalesce extending towards the base of the wing. When the basal and the S bands are not connected, the hyaline area between the two bands extends uninterruptedly towards the base of the wing, (Figs. 2 and 60). The connection between the S and the inverted V bands though strong in some individuals (Figs. 2 and 58) may be weak (Figs. 57 and 60) or lacking in others (Fig. 59). In many individuals

([18]) According to Greene the area is hexagonal and the flattened projection is not present, it being specific for *A. striata*.

there are two slightly lighter areas in the basal band on either side of the humeral cross vein. In dried or in specimens preserved in alcohol the spot on the dorsum is always visible.

Described from over 500 specimens reared from the different fruits in which the insect breeds collected in different localities in Puerto Rico including the lower and the higher elevations. Specimens in the collection of the Insular Experiment Station, P. R., reared from guava in 1913 and identified as *A. fraterculus* Wied., have also been studied.

Type.—A single female; (P. R. Ac. No. 45–33), March 20, 1933, Río Piedras, Puerto Rico; reared by F. Seín, Jr., from *Psidium guajava* L. In the U. S. National Museum, Washington, D. C.

Paratypes.—Four female specimens; (P. R. Ac. No. 45–33), March 20, 1933, Río Piedras, Puerto Rico, reared by F. Seín, Jr., from *Psidum guajava* L. In the British Museum, London, England, and at the Insular Experiment Station, Río Piedras, Puerto Rico.

Mounted wings from which the drawings of the variations in pattern, and slides from which the drawings of the posterior spiracles and the hairs or rays were made deposited at the Insular Experiment Station.

The egg: Length, 1 mm., width, 0.3 mm. Spindle shaped, both ends bluntly pointed and one with reticulations which may be indistinct in some cases, (Figs. 11–13). 'gg membrane opaque, smooth and glossy. Egg inserted in the fruit just underneath the cuticle, the reticulated end nearest to the cuticle.

Described from mature eggs dissected out of the female flies and from eggs laid in and on fruits in cages in the laboratory.

The larva: Similar in size and color and other characters to that of *A. fraterculus* Wied., var. *mombinpraeoptans* except that the bunches of hairs (rays) in the posterior spiracles are more numerous, closer together and not so branched, (Fig. 18), entrances more frequently convergent; number of tubules in anterior spiracles from 9 to 17, the lowest numbers have been found in rose apple and citrus and the highest also in citrus.

Described from 200 full grown larvae from the same source as the adults.

The puparium: Similar to that of *A. fraterculus* Wied., var. *mombinpraeoptans*. An occasional one may be formed inside the fruits in which the larvae have developed, a habit *A. fraterculus* Wied., var. *mombinpraeoptans* has not been observed to have.

Described from over 200 specimens from the same source as the larva.

Hosts: Guava "guayaba", *Psidum guajava* L.; rose apple, "pomarrosa", *Jambos jambos* L.; tropical almond, "almendra" *Terminalia catappa* L.; kunquat, *Fortunella margarita* (Champ) Swingle; star apple, "caimito", *Chysophyllum cainito* L.; zapodilla, "níspero", *Sapota achras* Mill.; custard apple or bullock's heart, "co razón", *Anona reticulata* L.; and beach plum, "hicaco", *Chrysobalanus icaco* L., occasionally, in the spring and early summer sporadically a few may breed in grapefruit, *Citrus maxima* Merril; sour orange, "naranja agria", *C. aurantium* L.; native and Valencia oranges, "chinas", *C. sinensis* L.

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PLATE X

Fig. 1.—*Anastrepha fraterculus* Wied., var. *mombinpraeoptans,* right wing, greatly magnified.

Fig. 2.—*Anastrepha unipuncta* n. sp. right wing, same magnification as fig. 1; notice that the bands are darker and that the basal and the S shaped band are disconnected.

Fig. 3.—*Anastrepha fraterculus* Wied., from Argentina, right wing. same magnification as figs. 1 and 2; notice that the wing is larger than the other two, that the S shaped band and the inverted V bands are more slender and that they are disconnected; in color the Argentinean is similar to the *mombinpraeoptans* variety and both are lighter than *A. unipuncta.*

Fig. 4.—*Anastrepha fraterculus* Wied., var. *mombinpraeoptans,* dorsal view of female adult greatly magnified; notice the three bright longitudinal sulphur yellow stripes on the thorax.

Fig. 5.—*Anstrepha unipuncta* n. sp., dorsal view of thorax, magnification about the same as in fig. 4; notice the dark spot on the suture between the metathorax and the scutellum not present in fig 4 and that the longitudinal stripes are dull and indistinct.

Fig. 6.—*Anastrepha fraterculus* Wied., var., *mombinpraeoptans,* the end of the egg protruding out of the cuticle of a green fruit, greatly magnified.

Fig. 7.—Same, the end of the egg protruding out of a ripe fruit.

Fig. 8.—Section of a green hog plum, *Spondias mombin* L., to show the egg as it is inserted by the female. In other fruits the egg is inserted in the same manner.

PLATE XI

Fig. 9.—*Anastrepha fraterculus* Wied., var. *mombinpraeoptans,* longitudinal section of egg, greatly magnified.

Fig. 10.—Same lateral view of egg with fruit tissues adhering to it as it usually appears when dissected out of fruits, not so greatly enlarged as Fig. 9.

Fig. 11.—*Anastrepha unipuncta*, n. sp., lateral view of egg showing reticulations at one end, magnification slightly more than Fig. 10 and very much less than Fig 9.

Fig. 12—Same, showing slight difference in shape and size.

Fig. 13—Same, showing some variation in shape and reticulations indistinct.

Fig. 14.—*A. fraterculus* Wied., var., *mombinpraeoptans*, lateral view of head of larva showing: Mth, mouth; Oh, oral hook; a, antenna, ASp, anterior spiracle, greatly magnified.

Fig. 15.—Same, anterior spiracle of mature larva, lateral view, greatly magnified.

Fig. 16—Same, lateral view of mature larva showing, VFa, ventral fusiform area, and 1 to 11, number of segments, greatly magnified.

Fig. 17.—Same, posterior spiracles of mature larva showing the hairs or rays well spaced and branched and the two entrances above parallel with the lower one obliquely upturned, greatly magnified.

Fig 18—*Anastrepha unipuncta*, n. sp. posterior spiracles of the female showing the hairs or rays more abundant, closer together and less branched than in Fig. 17, greatly magnified, entrances convergent.

Fig. 19.—*Anastrepha fraterculus* Wied., var., *mombinpraeoptans*, posterior spiracles of one third grown larva showing the two spiracular plates closer together than in the full grown larva in Fig. 17, but the hairs or rays about the same, greatly magnified.

Fig 20.—Same, mouth hooks of the full grown larva, lateral view showing the three parts, greatly magnified.

Figs. 21–25.—Same, mouth hooks of full grown larva, first and second parts of different individuals showing variations in the shape, greatly magnified.

Fig. 26.—Same, posterior end of full grown larva showing the tubercles: a and b, in profile, located in one ridge; c and d, in profile, located in two ridges; a and c, in profile, with inner tubercles bifid, greatly magnified.

Fig. 27.—Same, posterior spiracles of the mature larva showing the entrances convergent, hairs or rays not shown, greatly magnified.

Figs. 28–31.—*Anastrepha unipuncta* n. sp., posterior spiracles of the mature larva showing the two upper entrances horizontal and the lower one obliquely upturned, hairs or rays not shown, greatly magnified.

Plate XII

Fig. 32.—*Anastrepha fraterculus* Wied., var., *mombinpraeoptans,* lateral view of puparium showing: PSp, posterior spiracles; An, anus; Sp, lateral spiracle; P, vertical cleavage line; O, horizontal cleavage line; ASp, anterior spiracle; 1 to 11, number of segments, greatly magnified.

Fig. 33.—Same, lateral view of opened puparium after the emergence of the fly, ASp, anterior spiracle, greatly magnified.

Fig. 34.—Same, dorsal view of puparium showing: Asp, anterior spiracle; Mth, mouth; PSp, posterior spiracle, greatly magnified.

Fig. 35.—Same, ventral view of puparium showing AnP, the anal plate, greatly magnified.

Fig. 36.—Same, posterior spiracles of the puparium showing the broad flattened projection extending down between the upper end of the spiracular plates, greatly magnified.

Fig. 37.—Same, dorsal view of thorax showing the distribution of the dark colored pile, the whitish pile on the median mesoscutal vitta not showing, greatly magnified.

Fig. 38.—*Anastrepha unipuncta*, n. sp., dorsal view of thorax showing the distribution of the dark colored pile and the spot on the suture between the metathorax and the scutellum, greatly magnified.

Fig. 39.—Same, a variation in the shape of the spot between the metathorax and the scutellum, greatly magnified.

Fig. 40.—*Anastrepha fraterculus* Wied., var. *mombinpraeoptans,* external genitalia of the male showing the claspers, greatly magnified. The external genitalia of *A. unipuncta* show identical characters.

Fig. 41.—Same, lateral view of the ovipositor, greatly magnified.

Fig. 42.—*Anastrepha unipuncta*, n. sp., lateral view of the ovipositor, same magnification as Fig. 41; notice the difference in shape and size, Fig. 42 being wider at the middle and slightly longer than Fig. 41.

Plate XIII

Figs. 43 to 51.—*Anastrepha fraterculus* Wied., var. *mombinpraeoptans,* right wing of individuals showing variations in pattern, somewhat diagrammatic, greatly magnified.

Fig. 43.—Showing the connection between the S and the inverted V bands very weak.

Fig. 44.—The S band widening downwards and the inverted V band widening at the apex to make a wide connection.

Fig. 45.—The S and the inverted V bands connected at two points.

Fig. 46.—A wide connection between the S and the inverted V bands and the two arms of the inverted V band connected along the posterior margin of the wing.

Fig. 47.—Same, but the connection between the two bands still greater.

Fig. 48.—Same, but the arms of the inverted V band disconnected along the posterior margin of the wing.

Fig. 49.—The S and the inverted V bands connected at two points and the arms of the inverted V band connected along the posterior margin of the wing.

Fig. 50.—Same, but the arms of the inverted V band not connected along the posterior margin of the wing.

Fig. 51.—Same, the S and the inverted V bands almost connected near the tip of the wing in a striking manner.

PLATE XIV

Figs. 52 to 56.—*Anastrepha fraterculus* Wied., var. *mombinpraeoptans*, right wing of individuals showing variations in pattern, greatly magnified, somewhat diagrammatic.

Fig. 52.—A very wide connection between the S and the inverted V bands and a striking curve of the outer arm of the inverted V band.

Fig. 53 and 54.—Breaking up of the S and the inverted V bands by vacuoles.

Fig. 55.—The two arms of the inverted V band disconnected somewhat as described for *A. fraterculus* by Wiedemann in Brazil.

Fig. 56. -The two halves of the S band disconnected, a most unusual condition.

Figs. 57–60.—*Anastrepha unipuncta* n. sp., right wing of individuals showing variations in pattern, greatly magnified, somewhat diagrammatic.

Figs. 57 & 58.—A pattern similar to that of *A. fraterculus* Wied., var., *mombinpraeoptans*, (Fig. 1) differing from it only in being darker.

Fig. 59.—The S and the inverted V bands entirely disconnnected, a condition seldom if ever occurring in *A. fraterculus* Wied., var. *mombinpraeoptans*.

Fig. 60.—The basal and the S bands entirely disconnected, a condition not observed in *A. fraterculus* Wied., var., *mombinpraeoptans*.

PLATE X.

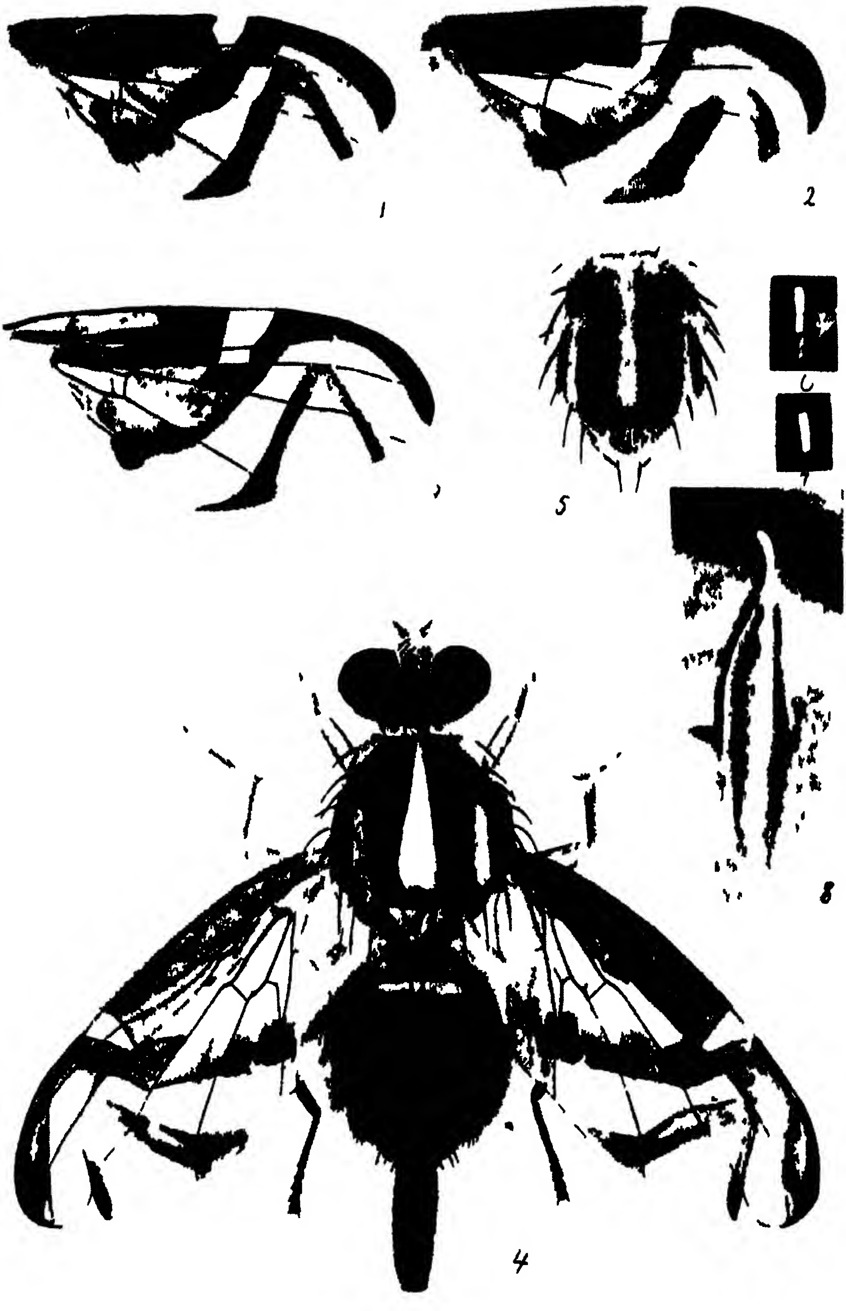


PLATE XI.

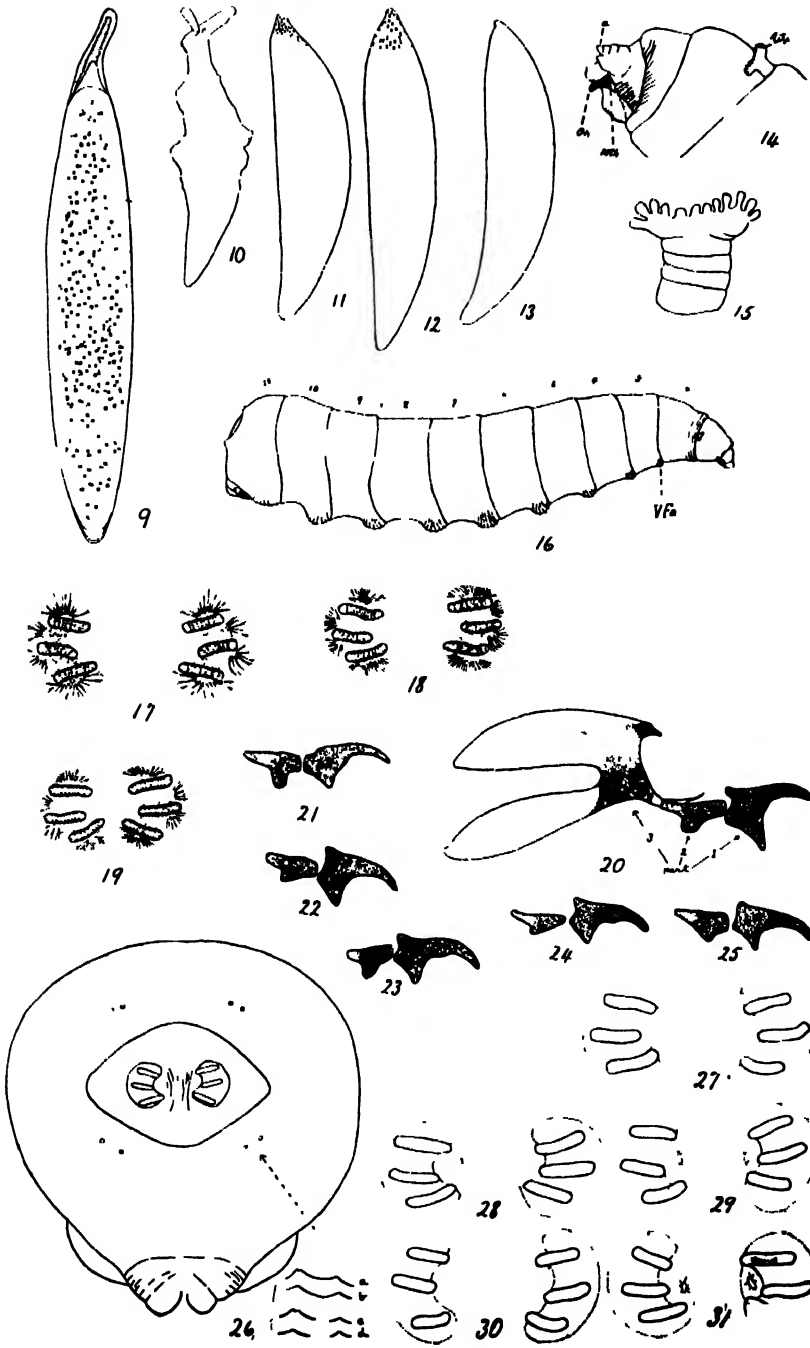


PLATE X.

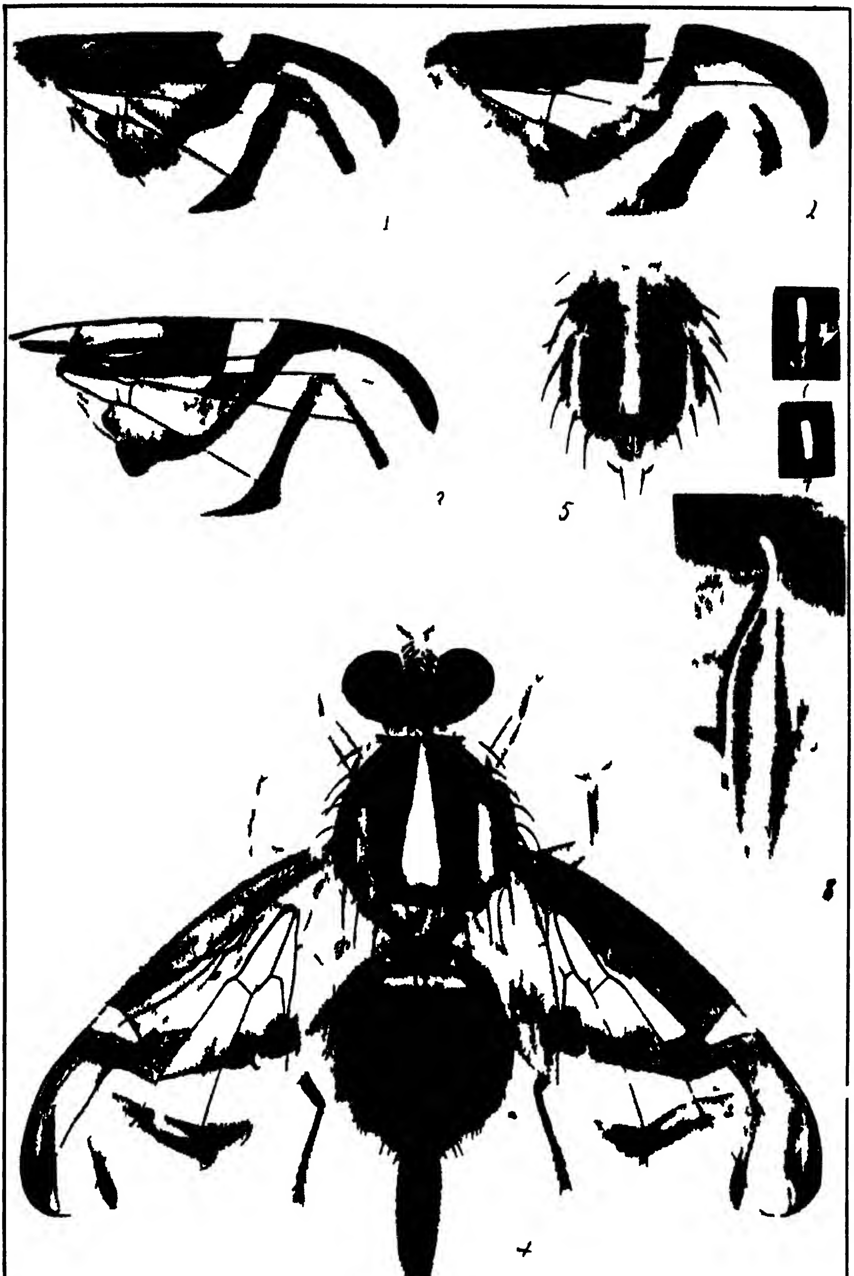


PLATE XIII.

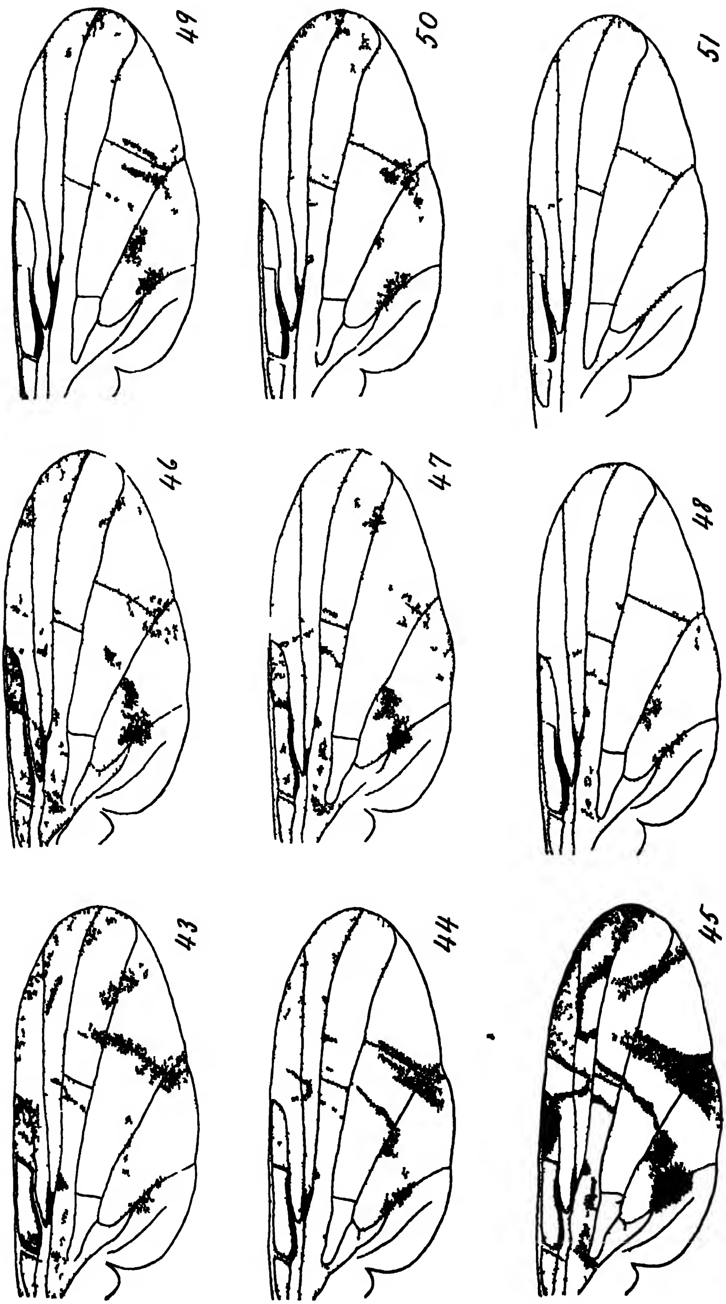
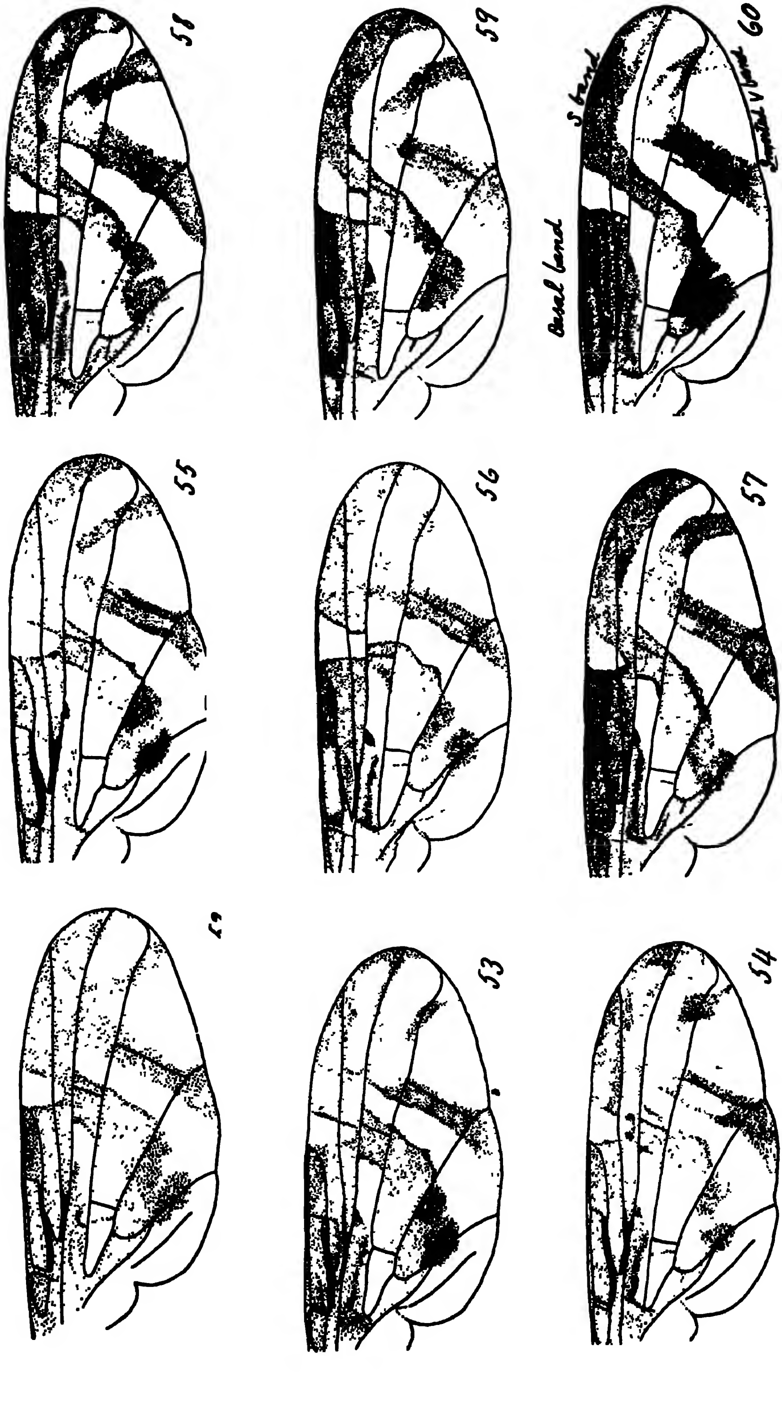


PLATE XIV.



THE EXTENT TO WHICH THE PRACTICE OF NOT BURNING CANE TRASH HAS BEEN ADOPTED IN PUERTO RICO

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For many years, most entomologists working on the problem of the control of the sugar-cane moth stalk borer, *Diatraea saccharalis* F., have been of the opinion that the burning of cane trash in the field, either before or after harvesting, favored the borer because the fire destroyed its natural enemy, the egg-parasite, *Trichogramma minutum* Riley, and have therefore unceasingly recommended to cane growers that the trash should not be burned when the fields are to be ratooned. Only in Puerto Rico have these recommendations been at all widely adopted, but no definite data heretofore have been available to show the extent to which the planters were following the practise of cutting cane without burning the trash, and raking it into alternate rows to permit of cultivation and irrigation of the ratoon cane.

On April 3d, 4th and 5th, 1933, the writer, accompanied by Mr. Richard Faxon, in charge of the local unit of the federal Bureau of Plant Quarantine, and Mr. U. C. Loftin, Senior Entomologist of Cotton Insect Investigations, U. S. Bureau of Entomology, made a trip around the island, and noted every field readily observable from the road in which the trash had, or had not, been burned. Before giving the figures, it should be noted that non-burning the trash is essentially a negative practise, and that the trash had not been burned at the time of observation does not by any means indicate or prove that it might not be burned later. To more than compensate for this error, due to not being able to predict what might happen in the future, is the fact that if the trash is burned before cutting, this is readily observable even before the cane is cut, and is given credit under the heading of "burned". Furthermore, it is impossible to determine until a field is actually being plowed, whether it is to be left for ratoons or plowed for planting, and it is quite possible that some fields recorded as "burned" will eventually be plowed, and should not have been entered. No entomologist has considered recommending non-burning of trash in fields to be plowed for planting, yet one field was observed at Central Mercedita, Ponce, which was being fitted for planting, and in which, very obviously, the trash had not been burned. It should also be noted that the practise of burning cane

This insect is quite active, the female traveling and moving about very freely nearly up to the time when she finally settles for egg-laying. The male is active up to the time when it settles down to makes its cocoon.

"The fluted scale exudes a great quantity of honeydew, and trees badly attacked by it are covered with the sooty fungus, characteristic of the black scale and the white fly.

"The remedy for this scale insect is always and emphatically to secure at once its natural and efficient enemy, the *Novius cardinalis*. Where this insect can not readily be secured, the scale may be kept in check by frequent sprayings with the kerosene or resin washes. Fumigation is comparatively ineffective against it, because the eggs are not destroyed by this treatment. Spraying is, for the same reason, effective only when it is repeated sufficiently often to destroy the young as they hatch."(1)

The above account of the cottony cushion scale and of its spectacular control in California has been reprinted here to indicate how generally it is considered that the problem of control of this pest is thoroly and completely solved. Yet upon examining the more recent publications from California, one discovers that control by the lady-beetle *Novius*, *Vedalia*, or *Rodolia cardinalis*, as it is now called, is by no means as effective as the earlier statements would lead one to suppose.

For instance, Prof. H. J. Quayle states that:

"While the cottony cushion scale is at present a pest of comparatively little consequence, it is still one of the commonest insects inquired about throughout the entire length of the State where citrus trees are grown. While the *cardinalis* is pretty well distributed over the State, and often appears unaided in an infestation of cottony cushion scale, yet in many cases it does not occur, and neither does the scale become very abundant. The checking of the scale in such cases must be accounted for through some other factors. Sometimes, too, the beetle is slow in getting the scale under control. On the station grounds at Riverside fifty or seventy-five orange trees have been infested with the cottony cushion scale, as bad as occurred when the insect was at its height, for at least four years. During this time also the ladybird beetle has been present. The scale becomes very abundant each spring when the *cardinalis* begins work and effectively checks them. The beetles are present in April, May, and June, and disappear in July. Some young scales are left and those have a chance to multiply and severely infest the trees again

before the *cardinalis* appears in the spring This has been the history of the infestation for the past four years "(3)

Nor is the relative value of the parasites introduced by Koebele finally settled, for, to quote from a recent book by Dr E O Essig "The dipterous parasite of the cottony cushion scale, *Cryptochaetum iceryae* (Williston), was one of the natural enemies of *Icerya purchasi* Mask, introduced by F S Crawford and Albert Koebele from Australia into California in 1888–9 The adults are 1 5 mm long, the head and the thorax metallic dark blue, and the abdomen iridescent green They are rather slow in movement, crawling slowly over the cottony cushion scale inserting one to several minute, oblong, oval, smooth, pearly white eggs preferably in the half grown hosts It is thought that a single female may lay as many as 200 eggs The young larvae are curious, semitransparent elongated maggots with black mouth hooks, the anterior half of the body bare, the posterior half ciliated and with two long tail like processes often twice the length of the body The full grown larvae are quite different The body becomes pear-shaped with two horn like tracheae and the tail-like processes extended to four or five times the length of the body The color becomes reddish from the contents in the alimentary canal The larvae live freely within the body cavity of the host feeding on the body fluids and apparently not seriously inconveniencing it, upon reaching maturity, however the host is eventually killed Several larvae may occur in a single scale insect Pupation occurs within the dead body of the host The puparia are yellow or reddish brown, oval, 2 mm long, with two horn-like projections There are five or six generations a year This parasite is often the most important natural check on the cottony cushion scale, but because of its small size and the concealed manner of attack, it has not been given due credit for its efficiency In the San Francisco Bay region it persists where the vedalia has long since passed away and keeps the scale insect under almost perfect control Practically every lot of the scale sent to the University for examination shows the work of the fly and it is with great difficulty that living specimens of this once common and abundant scale insect can be secured for student study In Southern California too this parasite has done much of the work claimed for the vedalia "(4)

Indeed, the whole problem of the cottony cushion scale, which was at one time thought to be finally settled and decided, is in fact still very much of a problem If this is the condition in California, where the insect has been present for so long, and investigators have

been working on it ever since it first appeared, one may anticipate that its status in a new and entirely different environment may be even more subject to unusual and unexpected conditions.

The first published record of the cottony cushion scale in Puerto Rico is a note by Dr. W. A. Hoffman (5), of the School of Tropical Medicine in San Juan, who first observed it on a hedge of casuarina or Australian pine, *Casuarina equisetifolia*, in the patio of the School, later noting it generally on this host elsewhere in San Juan. (See Pl. XV.) This was not the first known occurrence, however, for it had previously been collected on rose bushes in Santurce, a suburb of San Juan, over a year previously, and determined by Dr. Harold Morrison of the U. S. National Museum at Washington. This record was not published until July, 1932 (6), and then without special comment among hundreds of others, mostly of common or well-known insects. The early developments in the story of the cottony cushion scale in Puerto Rico are best told in an unpublished MS prepared by Dr. M. D. Leonard, at that time Chief of the Department of Entomology at the Insular Station. He said,—

"On October 21, 1931, Edmundo Martínez of the Insular Forest Service brought a small twig of Casuarina to the Station bearing two specimens of the cottony cushion scale. These had been brought to his Station by some woman of unknown name and address in Santurce, for identification. The extent of the infestation was not known. I sent these two specimens to Dr. Morrison under date of October 21, 1931 (the same day) for determination since I was not sure but that this might be *Icerya montserratensis*. I told Mr. Martínez at the time, however, that this was probably *purchasi*, the injurious citrus species, and urged that he and the other foresters be on the lookout for it on casuarina. I myself had often looked at the casuarina at the Forestal in Río Piedras but had seen no evidence of infestation by this or any other insect.

"On February 16 or 17, 1932, I received from Dr. Morrison a letter dated February 5, confirming my determination of the casuarina specimens as *I. purchasi*. I saw Mr. Martínez a day or two later at the Post Office in Río Piedras and told him of this and asked again that the foresters be on the lookout for it.

"At about the same time I told Mr. Faxon, Chief of the Federal Plant Quarantine Office, of this determination and asked that he and his inspectors be on the lookout for *purchasi* on both casuarina and citrus during their regular grove inspections.

"From then on I personally examined a number of casuarina trees and hedges around Santurce but saw none until the first week

in March when in company with Mr. C. E. Pemberton, Chief Entomologist of the Hawaiian Sugar Planters' Experiment Station, a light infestation was found on a few casuarina trees next to the Clínica Miramar at Stop 10, in Santurce. These were for the most part unhealthy looking insects and a considerable proportion of the few there had been eaten out by something.

"At this time I told Mr. Pemberton of the occurrence of *purchasi* here on roses and casuarina (both determined by Dr. Morrison) and concluded that it was so scarce and so restricted that nothing be done about control at that time.

"When Dr. Wolcott was in San Juan on March 4 and 5 to attend the International Sugar Cane Technologists' Congress, the infestation on the casuarina hedge at the Clínica Miramar had not yet been noticed. I next saw him on March 11 during the trip of the Technologists around the Island and on the 12th at Guánica told him of the occurrence of *purchasi* on roses and casuarina (3 infestations total only observed to date) and we examined many casuarinas in company with Dr. Pemberton. I still did not think it worth while to give this any publicity.

"I examined casuarinas at all stops in the Island tour between that date and March 15 but with negative results.

"On March 24, I believe it was, Dr. Wolcott wrote Commissioner Colón advising him, on my say-so, of the presence of *purchasi* in Puerto Rico and advised immediate extermination. I did not know this had been done however, until March 29. On this date I visited Mr. Barbour, Chief of the Insular Forest Service, to tell him that we had just recently discovered that the casuarina hedge in the Parque Muñoz Rivera in San Juan was generally infested and that light infestations occurred on one or two other hedges near the Union Club in Santurce. We also examined again carefully all the casuarina seedlings and larger trees at the Forestal with negative results. Mr. Barbour showed me a letter from Dr. Wolcott under date of March 19 urging that he watch carefully his casuarina seedlings in the nursery and saying that he had officially notified the Commissioner of the presence of *purchasi*.

"About this time Mr. Seín stated that he had found a rather bad infestation of what he had taken to be *Orthesia insignis* on the large casuarina hedge of the Colegio Puertorriqueño at Stop 15 in Santurce. The date was on February 26. This was now determined however as *I. purchasi*. He had recommended nicotine sulphate and soap. Some "gallego" plants, *Polysias Guilfoylei,* were also infested there.

"Based on Dr Wolcott's notice of March 24th to the Commissioner, a meeting of the Insular Plant Quarantine Board was called on March 31 to consider possible measures to be taken against the cottony cushion scale The history to-date in Puerto Rico was briefly reviewed and a resolution was made by Mr Lopez Domínguez and adopted to make a more thoro survey than had already been made of citrus and of casuarina especially in the vicinity of citrus groves as soon as practical and to determine, if possible, what agents may be holding the pest wherever it occurs

"The next day, April 1, I visited Mr Luciano's home in Santurce since Mr Luciano had written me the day before that he had just observed parasites of the cottony cushion scale working there There were present besides myself and Mr Luciano, Messrs Pemberton, and Anderson and Mills of the U S Plant Quarantine and Control Administration Office A dipterous maggot was found working in the hollowed-out egg-sacks of the scale on the rose bushes and in some cases 3 or 4 puparia present in one empty egg-sack Mr Luciano stated that he had observed these rose bushes infested for about 2 years now and that the infestation was lighter now than formerly There was no infestation on a number of casuarinas present in his garden Two or three days later several small Phorid flies emerged from specimens of infested scales This may possibly be *Syneura cocciphila* described from *I purchasi* in 1895, from Mexico Specimens were sent for determination to Washington thru Mr Faxon's office by the boat of April 7

"On April 2, Mr Pemberton and I found that a number of scales in the lightly infested casuarina hedge alongside of the Olimpo Court Apartments at Stop 10, Santurce, were parasitized by the Phorid fly

"Upon arrival at the Station Mr K M Fletcher was there with a badly infested branch from his grapefruit grove at Palo Seco He said a number of trees were infested, several badly so Messrs Pemberton and Seín and myself at once visited his grove and found that at least a dozen or fifteen trees had some branches badly encrusted with the insects and a number of other trees were lightly infested Most of the trouble occurred on the first two rows next to a large bamboo windbreak along the road A number of pigeon pea bushes next to the first row were also considerably infested Mr Fletcher stated that he had noticed this infestation over a month ago but it had just lately become much worse He claims to have seen this insect present in his grove off and on in small numbers for the last

20 years He had already scrubbed with brushes the larger branches of several trees previously, he said, badly infested

"I recommended an oil or nicotine and soap spray at once and the immediate introduction of the Australian ladybird beetle

"*April 4, 1932* In the morning I went with Mr Fletcher and Mr Wildman (of the Isabela grove adjoining Mr Fletcher's place) to see Commissioner Colón, and recommended introduction of the Vedalia beetles I prepared a cable at once to the Florida State Plant Board requesting a prompt shipment of the beetles by air-mail

"In the afternoon Fletcher's grove was again examined in company with representatives of the Insular and Federal Quarantine Services, Mr Pemberton and Mr Sims of the Nitrates Agencies

"During the next few days I told several of the leading citrus growers about the infestation at Fletcher's and showed them specimens of the insect.

"On April 8, in company with Messrs Anderson and Mills, of the Federal Plant Quarantine Office, we looked over Mr John Kohn's (at Bayamón) casuarina windbreak and adjoining grape fruit trees as well as a number of rose bushes Farther along the same road we found a light infestation on several trees in a large long casuarina windbreak and several grape fruit trees adjoining these as far as one tree in the 4th row from the windbreak lightly infested also The Manager could not be located that afternoon

"By previous arrangement I received from the Post Office in San Juan that night the shipment of 150 Vedalia puparia from Florida They left Gainesville on the afternoon of the 5th

"*April 9, 1932* I had arranged to distribute the Vedalias in Mr Fletcher's grove the first thing in the morning but was instructed by the Director to await the arrival of Dr Wolcott who had been put in charge of the cottony cushion scale campaign by order of the Commissioner

"*April 10, 1932* The Director, Dr Wolcott and I, released most of the Vedalias in Fletcher's grove in the morning—twelve boxes of them Two boxes were put out on infested trees recently discovered in the adjoining Isabela grove and two were taken back to the Station We then visited Mr John Kohn and later arranged with the Manager of the Guildermeister grove nearby to start spraying with oil at once."

All the known occurrences of the cottony cushion scale in Puerto Rico up to that time were in San Juan and Santurce, or in citrus groves a few miles west along the coast, and widely separated by swampy marsh land, pasture or cane fields from the main citrus

producing section of the Island. The area was so limited in extent that for a time it seemed possible that the insect might be absolutely exterminated, if effective measures could be brought to bear upon it. The real difficulty was to determine what measures would actually be effective in extermination. A study of available literature showed only control measures, not extermination. By general admission, the lady-beetle *Rodolia* was only relatively effective, always leaving a few scales after cleaning up major infestations. Spraying was admittedly ineffective, and recommendations as to what to spray were vague and unsatisfactory. All that one could be sure of was that pruning of infested branches and destruction by fire of infested hosts would certainly eliminate those scales at least. Such treatment was quite practical in some cases, but hardly applicable generally in Isabela Grove, the largest single citrus property on the Island. As a matter of fact, however, the infestation in this grove was soon found to be so general that both spraying and pruning were generally adopted, and temporarily held the pest in check. In the adjoining grove, Mr. Fletcher had had little success in spraying with prepared oil sprays, consequently the old fashioned "cold-stirred" emulsion, with an excess of whale oil soap, was used in Isabela Grove.

Thru the co-operation of Mr. Fletcher and Mr. Kohn, a power sprayer was made available for immediate use by the Department of Agriculture in spraying casuarinas in San Juan, and as soon as funds were made available in the next fiscal year, a new power sprayer was purchased for this work. The conduct of spraying operations was under the supervision of Mr. Adolfo Mayoral, who previously had considerable orchard-spraying experience. He carried on extensive experiments to determine the relative merit of various sprays, and as a result, later sprayings were confined to the use of "Kerecide", a local preparation of standard composition which used fusel oil as stabilizer. His experiments showed that no spray is of much value during showery or rainy weather; but during dry weather, this heavy oil spray gives close to 100 per cent control. San Juan is an island, and most of the infestations in Santurce are close to the ocean, in some cases the casuarina trees being actually on the beach. It is under such conditions that the heavy oils give best results. Little is known about the effectiveness of this or other sprays under inland conditions, for up to the present no similarly extensive inland infestations have been available for experimentation.

Spraying and pruning operations having been gotten under way in localities where infestations were known to exist, the next step was to determine, if possible, all infestations. All available means

of publicity were used. Dr Jaime Bagué, Sub-Commissioner of Agriculture, made announcements over the local radio broadcasting station He also supervised the preparation of a poster, showing by reproductions of photographs of the insect on casuarina, what the insect looked like and requesting that all suspicious material be submitted for inspection The text of the poster is as follows

GRAVE PELIGRO PARA NUESTRA AGRICULTURA

La Cochinilla Blanca ha aparecido recientemente en los pinos australianos, rosales y toronjales de San Juan y sus cercanías.

Esta plaga es sumamente peligrosa, pues en una época casi acabo con los naranjos en el Estado de California

Si usted encuentra dicho insecto en su jardín o en su huerto, ponga varios ejemplares en un frasco y envíelo a la Estación Experimental Insular, Río Piedras, P R

Coopere con nosotros a salvar la industria de toronjas de Puerto Rico que representa millones de dolares para el país

A short descriptive article was circulated by both the fruit-growers' organizations, and write-ups appeared in San Juan newspapers The aid of the Boy Scouts of the San Juan region was enlisted Regional meetings of the Agricultural Agents were held in Rio Piedras, Isabela, Ponce and Guayama, at which they were shown photographs of the insect (no live material was carried around the Island), and instructed to be on the constant look out for infestations While en route between these meetings the senior writer inspected many casuarina trees, especially along the east and northeast coast Later, a special inspection was made of the casuarinas and orange trees along the beach east from San Juan as far as Río Grande, the results being entirely negative

The immediate returns from this publicity were encouragingly meagre A few spider webs on casuarina needles were submitted by one anxious citrus grower, for these webs in size and color at least superficially resemble mature scales Mr Mariano Mari, in charge of the Demonstration Farm near Arecibo, noted an extensive infestation of the native cottony scale, *Icerya montserratensis* Riley & Howard, on orange, which he thought might be mixed with *Icerya purchasi* because many of the scales lacked the long waxy projections secreted by the native species. (See Plate XVI.) His suspicion was shown to be justified, when, a few days later, another infestation of *Icerya montserratensis,* on a single citrus tree at the Poultry Sub-Station at Pueblo Viejo, was discovered to be mixed with the Australian species. Several other large infestations were soon afterwards found in Pueblo Viejo, and a number of infestations in the

main Bayamón citrus district. A suburban resident on the Trujillo Alto road reported some scale on a rose bush which had been presented to him by a friend in Santurce. Scales were also found on the casuarinas besides the Las Monjas racetrack between Río Piedras and Santurce. All of these new records, however, were in the immediate vicinity of San Juan, and except in the one case where the scale had obviously been carried on the host, were to the west and southwest. No infestations were found to the east or far to the south, indicating that normal dispersion was resulting from the prevailing winds (from the east and northeast), and that this was by far the most important single factor in dispersion. (See Plate XVII.)

Even before the results of the publicity campaign were beginning to come in, Dr. Hoffman reported another infestation on causarina and citrus, west of Dorado, ten or twelve miles in an airline from San Juan and seven or eight miles west of Isabela Grove. At first this seemed to be an isolated outbreak, but later and more careful observations in this region disclosed an infestation in a few citrus trees just outside of Dorado. That only two infestations were discovered in this region is largely due to the scarcity of appropriate hosts, most of this region being in cane, pasture or coconuts. Their presence, however, and the complete absence of infestation east of San Juan, despite an abundance of suitable hosts, confirms the original observations on the importance of the prevailing wind as an agent in dispersion.

Farther west of Dorado than Dorado is west from San Juan, a small infestation was much later discovered on a windbreak of casuarinas in the hills back of Barceloneta, on the Florida road. This might have resulted from the scale being carried on an automobile, for the casuarinas were close to the main road into the grove, but it seems more likely that this infestation represents another chance wind infestation, a jump of at least twenty miles from the nearest other known infestation.

Just as the prevailing wind is the most important factor in natural dispersion of the cottony cushion scale, so humidity is the most important factor determining abundance. The north coast of Puerto Rico, where all known infestations of cottony cushion scale occur, has an annual rainfall of from 50 to 90 inches. The distribution of the rainfall is by no means uniform thruout the year, and in general the late winter and the spring months are the dryest. The cottony cushion scale has unquestionably been present for several years in Puerto Rico, but it appeared in noticeable and distinctive

abundance only during the exceptionally dry spring of 1932. As the spring advanced, new infestations were discovered every few days, and despite a strenuous campaign of spraying and pruning, new areas of even denser infestation were constantly appearing in unsprayed parts of groves The limited numbers of the Australian lady-beetles that could be released seemed quite unable to make an impression in the unsprayed areas where they had been released During February, March and the first three weeks in April, 1932, less than an inch of rain per month fell anywhere in the infested area, and it was towards the end of this prolonged drought that the scales became most numerous

The situation changed in May, 1932 when the average rainfall for the region was nearly 13 inches and during June, July and August, averaged over 7 inches per month For periods of four or five days at a time, rainfall would be almost continuous, and humidity would remain high, even when rain was not actually falling Temperatures were also high during most of this period, not only during the day but all night long It was a most uncomfortably hot and humid summer for people living in and near San Juan, and it was deadly for the cottony cushion scale In citrus groves well protected by windbreaks, humidity remained high at all times, and, fortunately for the growers most of the infestations were in windbreak-protected blocks Isabela Grove despite its proximity to the ocean, is exceptionally well protected for the citrus trees were originally planted in clearings thru primeaval forest, and this natural windbreak has been constantly reinforced since When the grove was examined in July, not a single live scale could be found When one considers that thousands of trees in this extensive property had been infested only two and a half months previously, and new outbreaks were constantly being discovered on unsprayed trees so fast than all the spraying equipment available could not treat them, the contrast was amazing A few lady-beetles had been released in this grove, but not a trace of them could be found in July and their presence at any time could have been only a very minor factor in the elimination of the scale Practically all of the infestations were found covered with a greyish-white fungus, never before observed in Puerto Rico Thru the courtesy of Miss Vera K Charles, this fungus was identified as *Spicaria* sp., and Mr E West of the Florida Station states that it is identical with what they call *Spicaria javanica*

Very heavy infestations of limited extent on citrus trees in pockets in the hills around Bayamón showed even more beautiful examples

of complete and very recent destruction of the scales by this fungus. Its distribution was not extensive at first, however, and on one scale infestation discovered at this time on a citrus grove in Pueblo Viejo which had shortly previously been sprayed with Bordeaux, none of the fungus was to be observed. The owner brought leaves and twigs covered with fungus-killed scale from Isabela Grove, and placed them in one tree, otherwise untreated, between others which he sprayed with kerosene emulsion. Two weeks later, all the scale had been killed on the tree where the fungus had been introduced, while many scales were still alive on the sprayed trees. Naturally the owner was enthusiastic about the value of the fungus, and he was rapidly placing leaves with fungus-killed scale in all parts of his grove. Fortunately for the success of his experiment, humidity remained high for several weeks thereafter, and when examined a month later, not a single live scale could be found in his grove. Another report of scale infestation, which could not be examined immediately, was later found to have been completely eliminated by the fungus.

Continuously high humidity for several days is absolutely essential for the successful use of *Spicaria.* This was abundantly demonstrated in one grove where the scale infestation extended from a knoll-protected hollow to the top of a wind-swept hill. Within a few weeks, not a scale was to be found in the hollow, but as one went up the hill, infestations increased in intensity. The citrus grove at Dorado was very imperfectly protected from the wind, and here the fungus never appeared. Its requirements of humidity are more exacting than of a similar entomogenous fungus, *Cephalosporium lecanii,* which in the nursery at Dorado killed many hemispherical scales, *Saissetia hemispherica* Targioni, and green scales, *Coccus viridis* Green, on young seedlings also infested with cottony cushion scale Experimentally, smears of its spores rubbed on scales on casuarina trees by Dr Mel. T. Cook, of this Station, gave entirely negative results in control. Apparently casuarina trees, generally planted as windbreaks, retain with their needle-like leaves too little humidity on themselves to permit of this fungus being of much value for killing scales on them. Temperature is not so important, for even at minimum winter (tropical) temperatures, *Spicaria* is at least partially effective, as was later indicated in a grove at Bayamón, observed in January 1933, with many freshly killed scales.

The entomogenous fungus, *Spicaria javanica,* is by far the most important factor in control of cottony cushion scale during rainy weather and under generally humid conditions. It is, however, not the only agency attacking the scale in addition to the introduced

lady-beetles. Mention has already been made, in Dr. Leonard's MS report, of the discovery of Phorid flies attacking and developing within mature scales, and his tentative determination of these flies was later confirmed by Messrs. C. T. Green and J. R. Malloch as *Syneura cocciphila* Coquillet.

"The next most important natural enemy in Puerto Rico is the lace-wing fly, *Chrysopa collaris* Schneider. The trash-carrying larvae were usually found feeding in colonies of the scale, often commonly so, and a number of adults were reared. The pupal period occupied only 5 or 6 days.

"The common lady-beetle, *Cycloneda sanguinea* L., was frequently found feeding both as adult and larvae on the scales and the larva of a moth, undoubtedly *Ereuntis minuscula* Wlsm. was several times observed making heavy inroads where the scales were thickly encrusting twigs or small branches."(7)

Even more interesting was the discovery by the junior author who was handling all the rearing work of the lady-beetles, that, among the scales brought in from Dorado as food for them, a few much smaller lady-beetle larvae were already present. They pupated when less than half the size of *Rodolia* larvae, the adults emerging being small, light red beetles, quite different from *Rodolia cardinalis* in size and color markings, and indeed differing from anything in the Station collection. They were entirely light red in color, except for black eyes, a black spot on each elytron, and a black margin at the base of the elytra and extending for a short distance along the sutural margin. The first specimens reared were sent to Washington for determination and Dr. Chapin replied that they were a new species. Later, additional immature material was collected at Dorado, which, together with other adults, was sent to the National Museum, where technical descriptions have been prepared by Drs. Chapin and Böving (8 and 9), the insect being named *Decadiomus pictus* Chapin.

A minute wasp parasite, *Cheiloneurus pulvinariae* Dozier, as determined by Mr. C. F. W. Meusebeck, was reared from cottony cushion scale by the junior writer in May, 1932. This parasite was originally described by Dr. Dozier from material reared from a soft scale of sugar-cane, *Pulvinaria icerya* Newstead, but which he considered as being "a hyperparasite on the primary parasite of this scale, *Aphycus flavus,* with which it is always reared."(10)

The original host in Puerto Rico of both this and the other recently discovered insects predaceous and parasitic on cottony cushion scale is the not very common native cottony scale, *Icerya montserra-*

iensis R & H The larvae and adults of *Rodolia* will also feed on this native scale, at least in captivity and indeed a few of them have been reared on this scale when a sufficient supply of the Australian species was not available The Phorid fly, *Syneura cocciphila* was originally, according to a letter from Dr Aldrich, "collected from *Icerya purchasi* at Victoria, Mexico, October 16, 1894, Magdalena, Sonora, Mexico, September 26, 1894, Tamaulipas, Mexico, November 30 1894 These are records from the type material Other specimens (in the National Museum collection) are from Sao Paulo, Brazil, collected by A Hempel, January 1899, from *Icerya brasiliensis*" To this is now added the rearing record from the native scale One parasite which has been reared only from the native scale is a small yellow Braconid wasp, of which the antennae, eyes and wing veins are black determined by Mr C F W Muesebeck as *Rhygoplus bicinctiventris* Ashmead

The high humidity of the late spring and early summer of 1932 was not only highly destructive of cottony cushion scale, but it also made the artificial rearing of the predaceous *Rodolia* lady beetles extremely difficult In all discussion of the rearing work, it must be kept in mind that no infestation of cottony cushion scale occurs within several miles of the Experiment Station at Río Piedras and it was not considered a desirable policy to establish colonies there in the open while facilities for rearing large supplies of food for the lady beetles were not available under cover Consequently, scales had to be brought in from elsewhere to feed the beetles, and often most of the scales collected at this time were either dead or dying from fungus attack, or became infected immediately they were brought to the insectary In this emergency, the casuarina hedge in the patio of the School of Tropical Medicine, where Dr Hoffman had first observed the scale and where it was still abundant, proved of great value in keeping a supply of the beetles alive Only a few pairs were released there originally, but they throve to such an extent that their progeny soon spread to adjacent scale-infested casuarina trees of the grounds around the U S Army barracks By the middle of September, hundreds of pupae could be collected here, and releases of beetles were made in all citrus groves where infestations of the scale still existed The combination of fungus in windbreak protected groves, with ladybeetles in those where protection from the wind was less perfect, had by the middle of September 1932, reduced infestations in citrus groves to insignificant numbers Indeed, it was rapidly becoming difficult to find places where beetles could be released to advantage, for the supply of food in sight for them was

so limited Had such conditions continued for only a short period longer, absolute extermination, which seemed so visionary six months previous, might have become a fact

In certain groves, the destruction of cottony cushion scale by *Spicaria javanica*, not only approached, but actually was 100 per cent perfect If such conditions had been general, the problem would have been solved In reality, however, certain parts of infested groves were so poorly protected by windbreaks that the fungus had little effect, and on the casuarina trees and hedges of San Juan and Santurce, none at all In a very few cases the *Rodolia* beetles destroyed every scale insect present, but in most cases a few scales would be found even where beetles were repeatedly released It was apparent that there was not enough food present to feed many lady-beetles or their larvae, but they usually failed to eat up even that little Where only a few scales were left on a small tree these could be destroyed by hand picking, but to care for other infestations on larger hosts, or widely scattered in a grove, some other means must be used The statement of Prof Essig regarding the relative efficiency of the Agromyzid fly, *Cryptochaetum iceryae*, and *Rodolia* already quoted), was so unequivocal that it seemed desirable to attempt the introduction of this parasite in Puerto Rico, and see if it would clean up what the beetles left Mr S A Rohwer, Acting Chief of the U S Bureau of Entomology referred the request for a shipment of these flies to Dr Stanley E Flanders of the Citrus Experiment Station Riverside, California for favorable action

This was the picture in the latter part of September 1932 cottony cushion scale absolutely eliminated in some groves where it had previously been very abundant, and greatly reduced everywhere else thru the activities of the lady beetles, of which an over abundant supply was available for release and distribution Even had the beetles failed, we knew what spray would give greatest effectiveness in control under local conditions, and an adequate sprayer and a trained spraying crew was available for any emergency In addition, a shipment of the Agromyzid parasite, *Cryptochaetum iceryae*, was confidently expected in the near future To be sure the distribution of the scale was quite extensive, but the situation was entirely under control and only time and a continuance of well organized activities were needed to successfully complete the campaign

During the night of September 26–27, 1932, the hurricane of San Ciprián swept the northern coast of Puerto Rico and entirely changed the status of the cottony cushion scale As was reported by the senior writer immediately afterwards, the hurricane had but little ef-

fect on soil insects, or on those living where they were well protected against its onslaught, but scale insects of all kinds suffered greatly. "The trunks and branches of trees exposed to the full force of the wind are smoothed of rough bark and all projections in a most surprising manner. Of course some scales persist in the crotches and on the petioles of leaves, but the breaking off of leaves, twigs and larger branches causes an immediate decrease in their numbers only exceeded by the mortality caused by the direct action of the wind and rain in rubbing the insects from their host."(11) Not only such large, fluffy and easily dislodged scales as *Icerya purchasi* were blown off of their host, but those with a tough, hard scale, closely appressed to the host, were also carried away. It was the rule, and not the exception, that 95 to 99 per cent of all the purple scales, *Lepidosaphes beckii* Newman, on citrus trees in the region affected by the hurricane, were removed overnight. In the next few weeks after the hurricane, no sign of cottony cushion scale could be found, even on hosts known to have been infested before the hurricane. Of course not every egg and every crawler had been destroyed, but it was a matter of months before the few surviving individuals could be found.

So far as can be determined from observations made in the following six months, the hurricane did not extend the distribution of the scale at all. No new infestations have been found since the hurricane, and apparently its actual effect it to destroy all those blown off the host, and not to carry them uninjured to a new host, miles away. The force of the hurricane wind is too great, and is destructive, rather than dispersive, of these soft, fluffy insects

Just a month after the hurricane, a shipment of scales heavily infested with *Cryptochaetum iceryae* was received. This shipment was mailed at Riverside, California on October 18th, 1932, and was delivered at the Station in Río Piedras on the 25th, having been sent by air-plane mail. Thirty flies had already emerged en route, and these were released on the date of receipt in two, protected casuarina hedges in Santurce where a very few large cottony cushion scales had survived the hurricane. For the next weeks, releases were made of twenty or thirty flies every other day in every place where scales were known to have been present before the hurricane, even tho none could be found at the time of release of the parasite. A few weeks later, when scales were more apparent, daily hand collection was organized in San Juan and Santurce, but not a fly emerged from any of this material collected where the releases had been made. Nor were any flies reared from scales collected in citrus groves where releases had been made, and it appears probable that the introduction

was a failure, largely because the sending was received at a time when so few scales were available to be parasitized.

This imported Agromyzid fly was not the only insect dependant on cottony cushion scale, of which greater numbers were present immediately after the hurricane than could be fed. Because of lack of food for them, or any means of obtaining it, all the live *Rodolia* beetles at the Station had to be released in a citrus grove in Bayamón which before the hurricane represented the heaviest infestation of scale known at that time. Besides these beetles in captivity, some in the open also survived the hurricane. That casuarina hedge in the patio of the School of Tropical Medicine, on which Dr. Hoffman had first observed the scale on this host, and on which *Rodolia* was breeding at the time of the hurricane, was so well protected against the force of the wind by the three story building of the school as to be practically undisturbed. On October 6th, ten days after the hurricane, about thirty fresh (unemerged) beetle pupae were noted on this hedge. They were not collected for release of the beetles elsewhere, for scanty as was the prospective supply of food for them on this hedge, just then it represented more of large scales than was present is all the rest of Puerto Rico. These few *Rodolia* beetles were all that survived the hurricane, and practically all of their progeny perished soon after from lack of food.

So far as is known, *Rodolia* beetles survived the post-hurricane scarcity of food in only one place. In January 1933, a single beetle was noted by Mr. Richard Faxon on some scale infested pigeon pea bushes growing across the street from his office in the Ochoa Building, possibly a mile to the west of the School of Tropical Medicine. In the next few weeks, a number of fresh (unemerged) pupae were collected here, to form the nucleus of renewed breeding operations at the Station.

Thru the courtesy of Dr. C. L. Marlatt, Chief of the Bureau of Entomology, a shipment of *Rodolia* beetles was received from the Cottony Cushion Scale Laboratory of the Bureau, at New Orleans, being mailed there by Mr. A. W. Cressman on February 7th, 1933, and received at the Station in Río Piedras on the morning of the 11th. This shipment contained 35 pupae when it left New Orleans, several of which transformed to adult en route, and all arrived alive and vigorous. Combined with the few beetles collected from the pigeon pea bushes opposite the Ochoa Building, this shipment gave the Station an ample supply for breeding, so that hundreds of beetles were ready for release by the middle of the spring of 1933.

The hurricane of San Ciprián unuestionably destroyed 99 per cent or more of all the cottony cushion scale alive in Puerto Rico on September 26, 1932, and for the first few weeks afterwards, no scale could be found. But a few individuals had survived, and in the succeeding months they were able to reproduce more rapidly than before because the hurricane had even more completely swept away their natural enemies, even including windbreaks. At first it seemed as tho it might be possible to destroy these few survivors, and a careful and intensive search was made in every place where the scale was known previously to have been present, and every individual discovered was collected or destroyed by hand. Young scales were found in various protected locations on the host, between petioles and twig, in crotches, and in greatest numbers at the edge of the callus growing over the wound where a branch had been sawed off. An obvious clue to their discovery on citrus trees was a line of the fire ant or "hormiga brava", *Solenopsis geminata* F., which had promptly adopted this Australian immigrant, and entered into even more active symbiosis with it than with most native soft scales and mealybugs. As a general rule, citrus trees with no ants are free from "honey-dew" producing mealybugs or soft scales. Where ants were present, young colonies of cottony cushion scale (or some other soft scale, or mealybug) were almost invariably present also. The hurricane had doubtless destroyed much of the usual food of the fire ant, and they were in consequence especially solicitous to preserve and care for any insect able to provide them with "honey-dew". In numerous cases they were observed to have built a structure of carton and earth over young colonies of cottony cushion scale located on callus margins of wounds, such structures being reminiscent of hurricane sheds, or "tormenteras", altho all were constructed after the hurricane, rather than before. Gradually, as the citrus trees put out new leaves, the scales began to appear exposed on the new leaves and on twigs, having left their pseudo-tormenteras and no longer receiving such intensive care from the ants.

During the remaining months of 1932, the numbers of the scale increased slowly, but with the beginning of dry weather in the early months of 1933, a very considerable increase in their numbers became apparent. In not a single place had the scale been entirely destroyed, despite constant watchfulness and hand collection. The earlier outbreaks on casuarinas in San Juan and Santurce were controlled by spraying, and by organizing a system of daily hand collections from a few trees which were not sprayed, an adequate supply of food was maintained to rear and have ready for general distribu-

tion hundreds of *Rodolia* beetles early in March. Because such an abundance of the beetles, lacking in 1932, was available and was released this year, no such tremendous increase in abundance of the scale as occurred in the spring of 1932, paralleling the practical absence of rainfall, was to be expected this year. Approximately three thousand beetles were released in March, April and May of 1933, effectually checking all incipient outbreaks and so thoroly cleaning up others as to almost approximate local extermination.

SUMMARY

1. The Cottony Cushion, or Fluted Scale of Australia, *Icerya purchasi* Maskell, is known to have been present on rosebushes in Puerto Rico since early in 1931, and presumably had been present for some time previously.

2. It first appeared in noticeable and destructive abundance on casuarinas (Australian pines) in San Juan and Santurce, and in citrus groves mostly less than ten miles to the west and southwest of San Juan, during the exceptionally dry spring of 1932.

3. Natural dispersion of the scale is by the prevailing north-east winds: from the original focus in San Juan and Santurce to the west and southwest.

4. In the citrus groves well protected by windbreaks, the scale was entirely eliminated by an entomogenous fungus, *Spicaria javanica,* never before recorded from Puerto Rico, which attacked it during the extremely wet weather of May 1932, and persisted during the following humid summer months.

5. The Australian lady beetle, *Rodolia (Novius) cardinalis* Mulsant, brought to Puerto Rico by airplane from Florida and later from New Orleans, is reasonably efficient in cleaning up scale infestations in less humid locations, such as exposed citrus groves, and on casuarinas growing close to the ocean or planted to serve as windbreaks.

6. Of native parasites, the most important is a Phorid fly, *Syneura cocciphila* Coquillet, originally described from Mexico, and never before found in Puerto Rico. The scale is also attacked by a wasp, *Cheiloneurus pulvinariae* Dozier, described from Puerto Rico, and by a small lady-beetle, *Decadiomus pictus* Chapin, a new and previously undescribed species.

7. During dry weather, almost perfect control is obtained by spraying with a standard heavy engine oil-fish oil soap emulsion, of which fusel oil is the stabilizer.

8. Except in special instances where especially well protected by

high buildings, all the large scales and practically all the small scales were carried away and destroyed by the hurricane of San Ciprián, September 26–27, 1932. A few scales in protected locations on their hosts escaped destruction and were later able to increase rapidly in abundance because the hurricane had been even more destructive of their natural enemies.

9. So far as can be determined, the hurricane had no effect in the dispersion of the scale.

List of Illustrations:

PLATE XV

The Cottony Cushion Scale, *Icerya purchasi* Maskell, on Casuarina or Australian Pine, *Casuarina equisetifolia.* Natural Size. (Photograph by Guillermo Rodríguez.)

PLATE XVI

The Cottony Cushion Scale, *Icerya purchasi* Maskell, (left) and a native cottony scale, *Icerya montserratensis* Riley & Howard, (right) on Casuarina or Australian Pine, *Casuarina equisetifolia.* Twice natural size. (Photograph by Guillermo Rodríguez.)

PLATE XVII

The Known Infestations of the Cottony Cushion Scale, *Icerya purchasi* Maskell, in Puerto Rico, before the Hurricane of San Ciprián, September 26–27, 1932:

Smaller cities and towns referred to in the text indicated by circles; infestations by solid black areas. (Original.)

PLATE XVIII

Outline map of Puerto Rico showing by Dots the Extreme Limits of Dispersion of the Cottony Cushion Scale, *Icerya purchasi* Maskell. For details of exact location of infestations, see Pl. XVII. (Original.)

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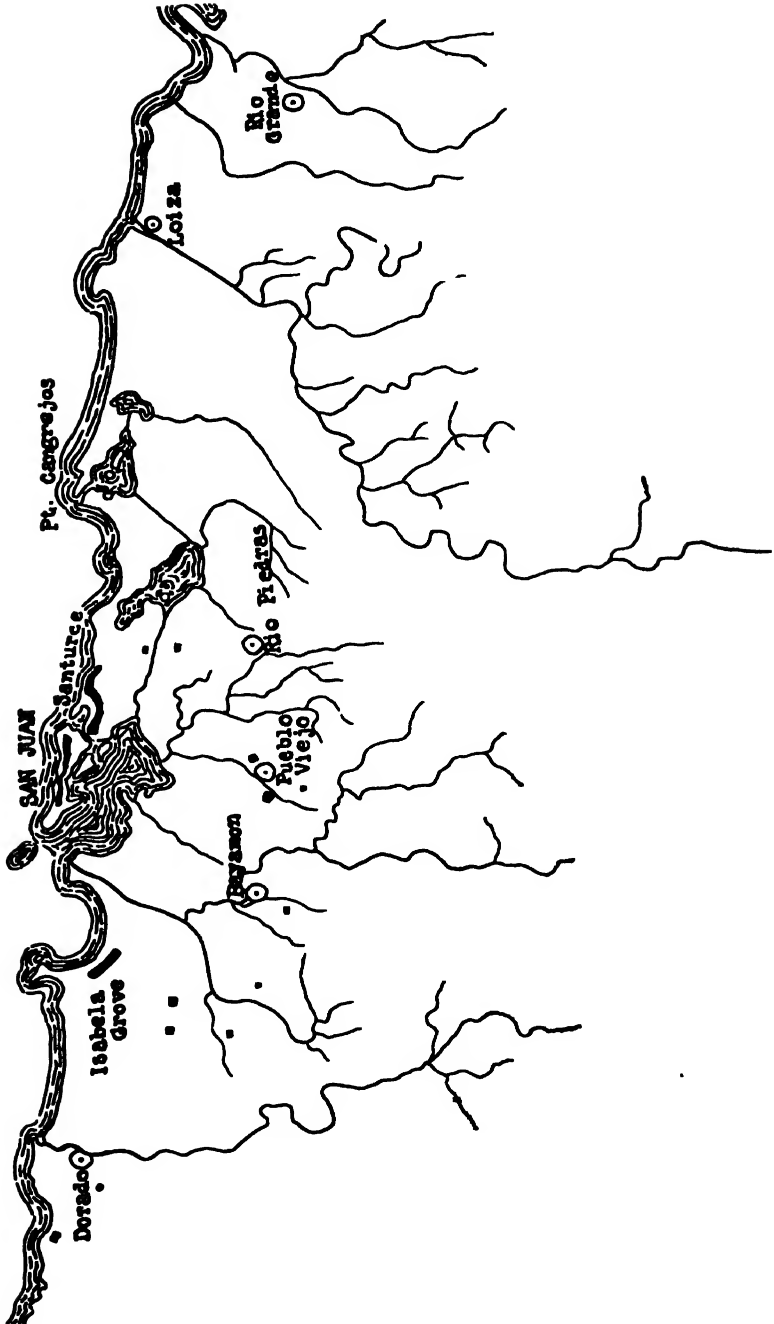
PLATE XV.

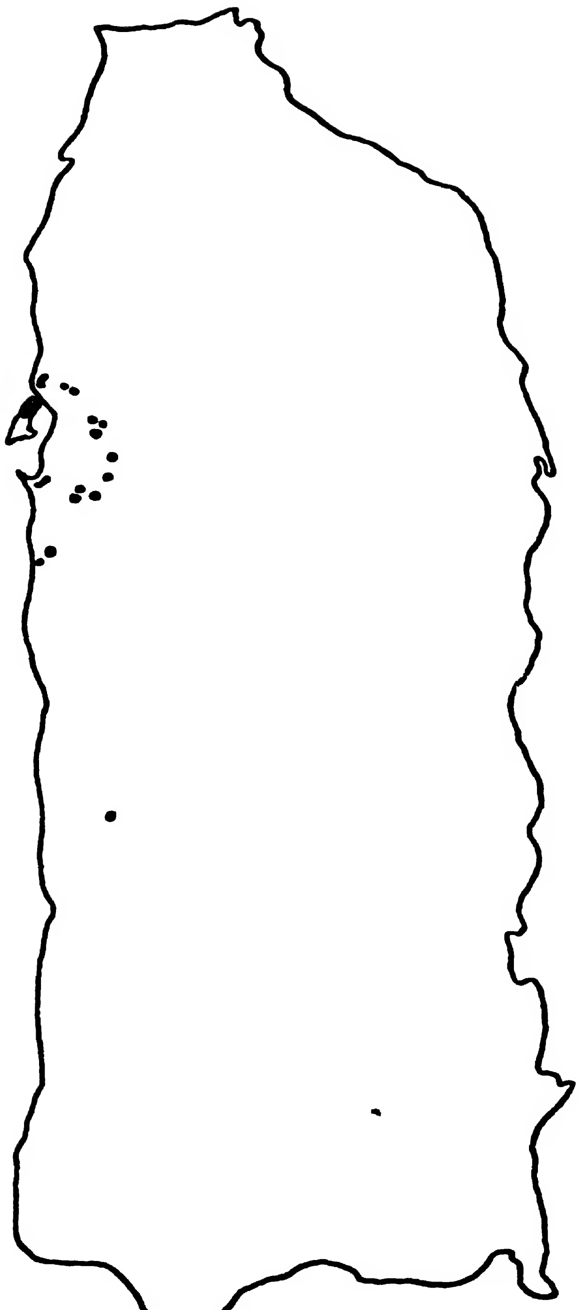
PLATE XVI.

PLATE XVII.



Rio Grande
Loiza
Pt. Cangrejos
Rio Piedras
Santurce
SAN JUAN
Pueblo Viejo
Bayamon
Isabela Grove
Dorado

PLATE XVIII.



RECENT EXPERIMENTS IN THE CONTROL OF TWO PUERTO RICAN ANTS

By George N. Wolcott, *Entomologist*,
Insular Experiment Station, Rio Piedras, P. R.

The control of ants in temperate zones is a comparatively simple matter, for ants there affect man directly mostly as household pests (and to only a minor degree in decreasing crop production), and against them in houses, simple and familiar methods of control have long been in use. As a natural consequence, comparatively little attention has been given to devising any new remedies. When a foreign ant, such as the so-called Argentine Ant, with most injurious habits, and not susceptible to the time worn and "old reliable" methods of control, does become established, adequate study of its habits and individual preferences eventually shows how it may be controlled (1). A comparable result may be confidently anticipated in the tropics when the importance of the various economic species is recognized and the control of each is considered a separate and distinct problem. To be sure, numerous species of ants are household pests in the tropics, but some of the same or often quite different species are of much greater importance as factors in affecting crop production. Their habits are often in the main, similar to those of the ants of temperate zones but in other cases are so completely different that they are only slightly inconvenienced if the methods of control so successfully used elsewhere against other species are tried out against them. Even and in many cases especially the Argentine Ant syrup—devised for use against this one ant and against no other—is a failure. The fundamental difficulty is that the most diverse of tropical ants are lumped together as one kind of insect, against which one standardized method of control should be effective. As a matter of fact they are as different and individual in their habits as tho they belonged to different orders of insects. In Puerto Rico, the country people speak of and recognize several kinds of ants, and most of them know at least the following:

1. "albaricoque", *Tapinoma melanocephala* F.
2. "albayalde", *Wasmannia auropunctata* Roger.
3. "barraco", *Odontomachus haematodes* L.
4. "hormiga brava", *Solenopsis geminata* F.
5. "hormiga loca", *Prenolepsis longicornis* Latreille.
6. "hormiguilla", *Myrmelachista ambigua ramulorum* Wheeler.

To be sure, this is hardly more than a tenth of the total number of kinds of ants found here by Dr. Wheeler (2), but it includes all the common and distinctive species. That so many can be distinguished by an ordinary person is the surest indication that in their activities, or some other factor affecting man, they are essentially and fundamentally different.

Of all the species of ants present in Puerto Rico, the fire ant or "hormiga brava" is by far the most abundant generally, and affects man in the most varied ways. It is a pest in citrus groves and in pineapple plantations, and as these crops earliest received attention at the newly organized Agricultural Experiment Station at Mayagüez, the first economic study of the hormiga brava in Puerto Rico was conducted there (3). The slender circular (undated and with not even the place of publication noted) detailing the results of these studies has long been out of print. Because the method of control there given is today just as effective and practical as when first devised, it is here reprinted without change. It should be noted, however, that the common mealybug of pineapples, in Puerto Rico as elsewhere, is *Pseudococcus brevipes* Cockerell.

PORTO RICO AGRICULTURAL EXPERIMENT STATION

D. W. MAY, *Special Agent in Charge*

CIRCULAR NO. 7

CONTROL OF THE BROWN ANT
(*Solenopsis geminata, Fab.*)
and the
MEALY BUG
(*Pseudococcus citri, Risso*)

IN PINEAPPLE PLANTATIONS

The brown ant and the mealy bug are at present doing considerable damage to pineapples. The brown ant alone seldom does any real damage; it is when it accompanies the mealy bug that the destructive work begins.

These ants are always found where mealy bugs are present, not eating the plants themselves, but attending the mealy bugs, carrying them from place to place, distributing them over the new leaves, and, as a reward for their labor, obtaining the honey dew which is secreted by the mealy bug. A few cases have been observed where the mealy bugs were so numerous that they irritated the fruit to such an extent that the juice began to run. This was eaten by the ants and they then continued to eat into the fruit, puncturing it and getting more of the juice. Some of these fruits were packed and shipped to New York, while others were kept at the Station. The fruits shipped to New York broke down and were unsalable. On examining a number of fruits after ten days, which is equal to the time elapsed in shipping, it was found that a fungus had gained entrance through these minute holes, causing the pines to break down.

LOCATION OF ANTS' NESTS

Ants generally attack the outer rows of plants first, gradually working in towards the center of the patch. The outer rows and borders of a pineapple field should be carefully watched and all ant hills destroyed as soon as found.

The nests of the brown ant are found in almost any part of the pineapple plantation; around the base of the plants, under the roots between the rows and in the paths, but more often they are found around the roots of the plant. When the nest is under the plant, the ants often carry sand and earth up into the plants and build other nests in leaf axils.

Upon examining these nests a great many mealy bugs are to be found. These are tended by the ants and distributed by them over the young leaves, and from plant to plant.

Before the flower stalk develops, the mealy bugs are found on the leaves around the center of the plant, especially between young leaves which are very close together, as these afford better protection for the insect. On fruiting plants, the mealy bugs are found on the flower stalk, also around the base of the fruit, and very often on the fruit itself.

NOTES ON SPRAYING

Kerosene emulsion, with a small amount of crude carbolic acid has given the most satisfactory results in killing the mealy bugs and the ants. Extensive tests with crude oil sprays have been made but none of these emulsions have proved as effective in killing the ants and mealy bugs as emulsions made with a low grade of kerosene oil and crude carbolic acid.

Formula for Spraying Pineapples.

2 gallons of kerosene
1 pint of crude carbolic acid
½ pound Fairbank's Blue Cloud Soap, or Good Caustic Potash Soap.
1 gallon of water

First put the oil in a barrel. Then dissolve the soap in the water with the carbolic acid by boiling, and pour into the barrel. Mix the whole with a spray pump by pumping back into the barrel for half an hour. A creamy mixture will be obtained which should hold up for from two to three weeks. This is to be used as a stock emulsion. Use 1 gallon of stock emulsion to 8 gallons of water.

ANTS' NESTS UNDER PLANTS

When there is an ants' nest directly under and around the plant, it is best to spray the nest first. If this is not done, the first drops of spray falling from the plant will startle the ants and they will immediately begin to move out carrying their young with them, and in this way many will escape the spray. When the nest is large, it is suggested that it be sprayed and then broken up with the nozzle forcing the spray down into the nest. In this way few ants have a chance to escape, but, as many of them are away feeding at the time, it is necessary to spray again the next day when the remaining ants will be busy building a new nest. This new nest is built close to the old one. All nests in the paths and between banks should be treated in the above manner.

An extension rod about three feet long is very handy in spraying pines, and an elbow is also advised so that the spray may readily be turned down between the leaves.

There is a time in the life of the pineapple plant when it should not be sprayed, that is, when the fruit bud is forming. At this time the bud is very delicate and any spray which will kill the mealy bug or ant, is liable to injure the bud. The spray does not always kill the blossom, but the fruit may develop without a top or crown. Fruits which have formed and stopped blossoming may be sprayed, but great care should be taken.

As the mealy bug is found between the central or the new leaves of the pine, a nozzle which throws a fine but forcible spray is ideal. The nozzle should not throw a spray which spreads over a great area, but one which can be directed down between the leaves, reaching a depth of eight inches and not spreading over an area of more than four inches. It is not the amount of spray that kills, but the spray that hits the mealy bug with force enough to remove the mealy coat and thus saturate the skin of the insect.

As the heart leaves of a pineapple are very small and lay very close to the next set of leaves, it is recommended that the nozzle be placed against one of the second row of leaves, thus spraying the outside of the heart leaf and the inside of the next leaf at the sale time. There are generally three sets of these leaves which come together in the above manner. It may seem impracticable to spray in this way, but, if the nozzle is not inserted between the heart leaves, the mealy bug will not be killed. To spray in this way takes a little longer than filling the crown, but after one has become accustomed to the work, it can be done very quickly.

When pines are sprayed in this manner the emulsion runs down over the central portion of the plant, filling up the crown and gradually running down around the roots.

W. V. TOWER,
Entomologist.

Mr. Tower, continuing his observation on the hormiga brava as it affected citrus growing (4), states that on fruits, "the scars made by ants are altogether different from those produced by the wind, the former being deep-seated and caused by the insects removing some of the epidermis and eating into the fruit.

"There are several species of ants which feed upon the nectar secreted by the orange blossoms. The brown ant and the little black ant are especially fond of the nectar. These two species have been seen working in the blossoms in the early morning, sipping the nectar, and toward noon, when it has been exhausted, attacking the unopened blossoms, or young fruit. Some cases have been observed where the green calyx leaves were eaten so badly that the fruit dropped. In other cases the pistil was chewed off and the fruit never developed. Again, the brown ant sometimes cuts holes in the young fruit.

"Ants do more damage during years when there is scanty bloom or when the bloom extends over a prolonged period, as they eat the fruit when not supplied with sufficient nectar.

"Ants are always found where the white fly and the Lecanium scale are present. They attend these two insects to obtain the honey-dew secreted by them. When their supply of food is suddenly cut off, ants often attack the young, tender shoots of the orange, eating them at the point where they join the branches. They also eat young, tender leaves, and a few cases have been observed where they had cut holes in ripe fruit. Under these conditions much damage is done. They also carry sand up around the base of the trees, and when there is scant food supply they gnaw the bark of the tree where it is covered by their sand houses. Often when pineapples have been removed from between rows of orange trees ants attack the latter in great numbers, scarring the trees, eating young, tender shoots and cutting holes in the fruit.

"When they appear in this way they must be killed by spraying. The simplest and most inexpensive spray that has been used is carbolic acid soap. The following formula has been used with great success:

Water	1 quart
Soap (Good's caustic potash or whale-oil, or Fairbank's blue-cloud soap)	½ pound
Crude Carbolic Acid, 100 per cent (dark)	1 pint

"Dissolve the soap in water and add the crude carbolic acid, then add sufficient water to make two quarts. This should be used as a stock solution, using one pint of the stock to six gallons of water.

"In spraying for ants it is advisable to locate the nests and destroy the ants by spraying down into them. A second spraying is always necessary the following day, as many of the ants are away from their nests at the first spraying. In spraying large nests it is a good plan to first spray a circle around the nest and then to spray directly into it, thus making it impossible for the ants to crawl out and insuring their being killed by the emulsion."

In the following years, when the Yothers formula for making the "cold-stirred" engine oil emulsion had been generally adopted by citrus growers for the control of scale, it was found that by adding a small amount of crude carbolic acid (one pint to 25 or 50 gallons of spray, or one-half to one-quarter of 1 per cent), this oil spray could be made also toxic to ants, and for an extended period would protect the trees sprayed with it from ant attack. Numerous growers, especially those in whose groves ants were especially troublesome, came to add the crude carbolic acid as a routine practise. It must be admitted that its use was not exactly popular, for its effect is to

quickly rot the rubber gaskets and other rubber parts of the spraying apparatus coming in direct contact with the spray. In other respects, however, crude carbolic acid meets every requirement, for it is cheap, easy to apply and unquestionably effective in killing ants. In the case of many insecticides, a purer or finer (and more expensive) grade of poison is necessary if injury to the plant is to be avoided, but in the case of carbolic acid, the effectiveness resides largely in crudities present with the acid. Consequently, the dark, unpurified and cheapest grades (containing the smallest amounts of carbolic acid) are the most desirable for insecticidal purposes.

A little later, when commercial manufacturers began placing oil emulsions or "miscible oils" on the market which were equally effective in killing scale, and much easier to use because they need only to be diluted with water, many growers ceased to make up their own sprays and relied entirely on the commercial product. Some of these contained some crude carbolic acid, added by the manufacturer for ease in making the emulsion and not for any insecticidal value the substance might have, but others contained none. No stress was laid on whether the product did, or did not, contain enough crude carbolic acid to kill ants, and in general, most growers did not consider this factor in making their selection from the numerous products recommended primarily (and usually solely) for killing scales. Of course, most groves on the Island are mature and established now, and suffer less noticeable ant injury; but in nurseries and young groves ants are no less abundant or injurious than they have been formerly, and the need for a means of control is just as great as ever. Theoretically, the problem of control of hormiga brava by means of crude carbolic acid emulsion is solved; practically, from the standpoint of large growers who no longer make up their own spray concentrates, it is not.

Of the poisons which have come into more general use since the war, the one which has been used with the greatest success in ant control is thallium sulfate. Considerable newspaper publicity at the time was given to successful demonstrations in destroying ants by means of a thallium syrup, conducted in the White House by Dr. R. T. Cotton, formerly of this Station. He furnished a small amount of this expensive and most virulent poison for conducting experiments in the control of the hormiga brava in Puerto Rico. His methods (5) were followed exactly at first, using the formula of one-fourteenth of an ounce of thallium sulfate dissolved by boiling in a pint of water, to which is added a pound of sugar and three ounces of honey. A trial was made of the paraffined pill boxes which he

had found useful as containers for the syrup. These containers serve reasonably well in houses, if not disturbed by children, pets or servants, but out-of-doors in citrus groves, they quickly go to pieces. The experiments were continued with paraffined paper cups, all of one piece of tougher paper, over which a cap fits, manufactured especially for this purpose by the Antrol Laboratories of Los Angeles. Such cups were used in all later experiments and were much more satisfactory. The experiments were conducted in the small citrus grove back of the Sub-Station building at Isabela, and in lawns and flower gardens near-by. In all cases, the ants appeared to feed on the syrup at first, but so far as one could judge, were but little affected by it, and soon learned to avoid it entirely. The results were uniformly discouraging, for in no case was even a small colony of ants completely destroyed, and no apparent impression was made on larger colonies. If the cup was placed at the entrance of the nest, the ants constructed a new entrance several feet away. If a fresh cup was placed at the new entrance, this also was deserted. One large colony in a lawn constructed six new entrances thus in succession, and while some of the ants may have been killed by the poison, no permanent reduction in their numbers was observable. If the cup was placed at the base of a citrus tree, where the ants were ascending and descending, they soon moved their line of march so as to avoid coming near the cup, and if another cup was placed in the new line of march, this also the ants soon learned to avoid. A final and definite experiment planned in the citrus grove at Isabela, laid out at the time of the experimenter's departure, appeared to be a complete success, when examined about two months later. This apparent success was entirely due, however, to the trees and nests having been sprayed by the mayordomo with crude carbolic acid emulsion a few days previous to examination. He had given up hope of the thallium syrup having any effect, and was determined to save the trees from ant injury by a method of the efficiency of which he had been convinced by demonstration on the main block of trees.

In most marked contrast of the uniform failure of thallium out of doors, the syrup was most unexpectedly successful when used in the house, and has since proved uniformly valuable in every experiment since conducted. A cup of syrup placed on the line of march of ants going from their nest to a garbage pail, food safe, bread box or refrigerator, will, within a few hours, eliminate them entirely from their chosen food, and in less than a day they will cease to visit the cup of poison syrup. Weeks later they may again return, but putting the cup out again on the line of march will disperse them more

quickly than before. The syrup is of no value when placed with or beside the food, but when several feet nearer the nest than the food, works with almost magical effect. Collapsible tubes of this syrup can be purchased locally and can be recommended to housekeepers who are not interested in the home preparation of the poison syrup.

While these experiments were being conducted, reports of the successful use of this poison syrup in the citrus groves of the Río Grande Valley of south Texas were received (6), and Mr. C. H. Behse, Jr., of the Gulf States Chemical Co. of Harlingen, Texas, came to Puerto Rico to try out some of the mixtures which had proved so successful in south Texas. His experiments in the citrus groves here were no more successful than those conducted by the writer, and as a result of their failure, he submitted additional mixtures, of varying composition, to be tested here. One of these was his standard dry pellets in a collapsible tube, another the syrup in a tube, a third a combination with dried blood, and a fourth, an unknown mixture, dark in color. All of these were placed at the base and higher up in the crotches of large citrus trees near the beach at Dorado, all trees being heavily infested with hormiga brava. After several weeks, they were replaced with fresh tubes. As the supply of tubes containing the unknown were exhausted, these were replaced with a mixture of thallium acetate and ground meat. In some cases, a possible diminution in the number of ants might be imagined on some of these trees, especially those on which the standard syrup was present, but in no case was it sufficiently marked to be considered as constituting even commercial control. After several months, additional fresh tubes and thallium acetate and meat were placed on the trees, but after the lapse of several more months, no more definite results consequent on the presence of the poison could be observed than before.

As a final conclusion to this poison experiment, to parallel a similar experiment previously conducted with the "hormiguilla", a mixture of Hamburg steak and sodium cyanide was placed at the check trees, which had not previously been treated with any poison. The action of the fresh meat on the cyanide is to cause the immediate liberation of hydrocyanic acid gas, which kills all the ants coming anywhere near the meat. Within a few minutes after application thousands of ants were killed, but some were still running about a few hours later, and when the trees were examined a few weeks later, some of the colonies appeared even larger than before. Before making a fresh application of meat and cyanide, all the loose sand at the base of the trees was brushed away, so that the meat could be placed

in close contact with the base of the tree and no ants descending to their nest could avoid it. Within a few minutes thousands of ants were killed, and by moving the bits of meat about so that they rested beneath runways not at first covered, all the ants in sight were soon killed. Brushing away still more of the sand and exposing some of the ants in the nest, these also were quickly killed by placing the meat in their midst. As an indication of how rapid was the action of the poison when properly applied, the case should be mentioned of one tree which had been densely over-run with hormiga brava tending cottony cushion scale. After a few minutes, it was so completely freed of ants that it could be ascended with safety, without danger of being bitten. Meat unmixed with cyanide is very attractive to hormiga brava, but no case was noted of the ants attempting to eat the poisoned meat. In this respect their action was very different from that of the "hormiguilla", a slow-moving, phlegmatic ant which remains quietly in one place eating the poisoned meat until overcome by the hydrocyanic acid fumes. The action of the cyanide and the meat rapidly destroys the great majority of the foraging workers, but some remain uninjured and unaffected deep in the ground. Thus the colony is greatly weakened, but not exterminated. It is not an especially cheap or simple method of killing ants, but it was some satisfaction to see some dead ants after vainly putting out thallium mixtures for so many months. Indeed, it is no more effective than dusting the nests with calcium cyanide dust, a much simpler method of obtaining the same result: the immediate destruction of the great majority of the ants.

The local agency handling the thallium tubes manufactured by Mr. Behse's company reported one rather considerable sale of them to a citrus grower near Barceloneta. He reported that his experience with them had been most successful, and his grove was visited to determine, if possible, the cause of his success. The tubes had been placed in a young grove after the ground between the trees had been thoroly cultivated in preparation for growing vegetables, and after the young trees had been thoroly sprayed, so that most of them were at least commercially free of scale. It is hardly surprising, therefore that after nine-tenths of the ant nests had been broken up by plowing and cultivation, and the main source of food for the ants (the honey dew from the soft scales on the citrus trees) removed, the few survivors had been destroyed by the poison bait. In every case where all the soft scales on a tree had not been killed by spraying, it was invariably heavily infested with ants, indicating that the successful results claimed for the poison were in reality largely due to starvation.

The thallium tubes may be of some value in carefully cultivated and sprayed young groves, but they are really a minor factor in ant control Even better results might much more easily and cheaply be attained by adding the requisite amount of crude carbolic acid to the oil emulsion spray used to kill the scale

The 'hormiguilla'' or coffee shade tree ant, *Myrmelachista ambigua ramulorum* Wheeler, is a small ant with reddish-yellow thorax and blue-black head and abdomen that "nests in populous colonies in the hollow twigs of trees, especially the sea-grape and "torchuelo" (2), but in coffee groves it nests in the older guaba or guamá (*Inga vera* and *Inga laurina*) trees, and when these are heavily infested, it also attacks the coffee trees The ants eat out irregular longitudinal tunnels in the main trunk and branches of the trees and seldom live in colonies in dead wood In some compartments of their tunnels they rear their young, in others they care for mealbugs, *Pseudococcus citri* Risso, or the peculiar pink fleshy scale insects, *Crytostigma inquilina* Newstead, that suck sap from the tree and secrete a honey-dew which is very attractive to the ants The most noticeable outward indication that coffee trees show of their being infested with the hormiguilla is a peculiar swollen, warty growth of bark where the lateral branches join the main trunk The tunnels of the hormiguilla are discontinuous and seldom of uniform size Parts of the infested branches will be entirely uninjured, while in other places the tunnels will be so broad as to greatly weaken the trees, so that they are easily broken in storms or when the berries are being picked. The scale insects and the mealybugs which the ants care for and largely depend on for food, obtain their nourishment from the sap of the tree, and even a light infestation of the hormiguilla reduces the vitality of the coffee trees so that they produce only small crops. A heavy infestation kills the top branches, and very rarely the entire tree is killed Most growers consider the hormiguilla the most serious and destructive insect pest in their groves

The old guaba and guamá trees in a coffee grove are the centers from which the ants go out to establish other colonies in the coffee trees, and the destruction of these old trees and the planting of new shade will eliminate the hormiguilla for several years The smoke of charcoal fires has no effect on the hormiguilla, except, naturally, that many ants perish when the trees in which they have been living are cut down and used in making charcoal

But the cutting down of these old shade trees is not always practicable, and in such cases the number of hormiguilla nesting in them can be very considerably reduced by poisoning them. Because the

hormiguilla has no one main nest, and because most of the ants remain within their tunnels in the tree most of the time, comparatively few are killed by a spray of carbolic acid emulsion, or by dusting with calcium cyanide. Altho the ants feed on the sweet excrement of their mealybugs and scale insects, they are not attracted by poisoned sweet substances prepared by man for their destruction. The Argentine Ant syrup they ignore entirely. But it was observed that they are attracted by dead insects and bird droppings that happen to occur on the leaves of infested trees, and when bits of meat, fish or cheese are placed on the trees, these are soon surrounded by ants feeding upon them. After numerous experiments with various kinds of poisons, it was discovered that potassium or sodium cyanide, powdered and mixed with meat would attract and kill the hormiguilla. The ants stay within their tunnels when it is rainy, and can not be enticed out even by fresh meat, and no poisoning should be attempted except during dry weather. At such times, a mixture of one pound of meat with two ounces of powdered sodium cyanide may be applied in the form of little shelves beneath the places where the ants are abundant, where the bark is rough or there are cuts in it to which the plastic mixture will adhere. The moisture and acid of the meat reacts on the poison to set free a very poisonous gas, hydrocyanic acid, which is lighter than air, and therefore kills only the ants that are above the little shelf. The gas acts on the ants promptly, but if they fall to the ground, they will eventually recover from its effects. But if the meat is placed in the form of a shelf so that the ants overcome by the poisonous fumes do not fall off but remain within its influence for even a few minutes longer, they will be dead.

During the years 1923–24 extensive experiments in this method of destroying the hormiguilla were conducted. Three applications of poisoned meat, at intervals of two or three days, killed practically all of the ants on a rather lightly infested guamá tree near Mayagüez. On three other trees, much more heavily infested, the same number of applications killed many more ants, but considerable numbers survived. An experiment was started in November and continued throughout the winter and spring on a large jagüey tree in the Ciales valley near Manatí, which was heavily infested with hormiguilla. In all, eight applications (Nov. 5, Dec. 13, Dec. 28, Jan. 14, March 3, March 17, April 3 and April 8) of the poisoned meat were made, using a pound of meat and one or two ounces of poison for each application. Altho enormous numbers of ants were killed, and at each successive application the decrease in the ant population was noticeable, yet the applications were made at too great intervals

for maximum effectiveness, and the tree was still somewhat infested at the time the last application was made.

As the experiment was continued, certain refinements of methods were adopted. By smearing the very smallest amount of unpoisoned meat about half an inch above the point where the poisoned meat shelf was to be placed, the ants could be induced to collect there and be overcome by the fumes of poison rising from the shelf beneath. The hydrocyanic acid gas is generated in the greatest quantity in the first few minutes after the cyanide is mixed with the meat, and is most effective the more promptly it can be applied to the tree. It continues to be generated for several days, but in much smaller amounts after the first few hours. If the meat does not dry out, it is effective for a considerable period, and has been observed to kill ants five hours after application. Also, the poisoned meat begins to harden soon after mixing, and the more promptly it can be applied, the more easily it can be shaped into a shelf, and the better it sticks. Thus, during the later experiments, only half a pound of meat and an ounce of poison were mixed at a time, the second half pound being mixed and applied some time later. From one shelf, the dead ants were collected and found to number 2,400. If all the shelves were as favorably located, and killing with this efficiency, the total number of ants killed on a large tree would be enormous. The ants killed should weigh almost as much as the meat, for their dead bodies pile up on the shelves so as to bulk larger than the shelves themselves, when not blown away by the wind.

This method of killing hormiguilla, despite the enormous numbers of ants killed, does not destroy the colony, and merely reduces the infestation. But their numbers can be so greatly lessened that old guaba and guamá trees which can not readily be removed, may safely be retained in the grove, if repeated applications of poisoned meat are made at intervals of a few days during dry weather. In practise, the use of ground meat and cyanide is too expensive and troublesome, and is not sufficiently effective to be whole-heartedly recommended to coffee growers generally. So far as known, it has never been used commercially, and, indeed the need for any artificial method of destroying the coffee shade tree ant was largely obviated, temporarily at least, by the hurricane of San Felipe, which blew down most of the older and larger shade trees in the coffee groves of the Island.

As the young shade trees grow larger however, they begin to harbor injurious numbers of hormiguilla, and eventually the problem of their economical control will again become pressing. Thus, at the same time that experiments were being conducted with thallium sul-

fate against hormiga brava, parallel ones were started with this substance against the hormiguilla. A guamá tree, well infested with the hormiguilla was found only a short distance from the Sub-Station at Isabela, and preliminary experiments were commenced on it. The sulfate of thallium is very sparingly soluble in water, but it was hoped that a small amount of the finest powder mixed with ground fresh meat might dissolve. Judging by the results of the first experiment, none did so, for no apparent diminution was noted in the size of the colony after several weeks. When the poisoned meat was first placed on the tree, the ants swarmed about in their characteristic manner, devouring it greedily, but picking out and discarding any particle of the poison, minute to us but enormous to the ant, found mixed with meat. As the obvious cause of the failure of this experiment was that the poison was not in solution, a small amount of powder was cooked up with Campbell's mock turtle soup, and boiled until it was a thick paste The ants were not the least bit deceived by the pseudo-meaty flavor of this mixture, and paid absolutely no attention to it.

Shortly after the ignominious failure of these experiments, Mr. Behse suggested the use of one of the more soluble compounds of thallium, stating that, in his experience, vastly more than the amount of thallium acetate necessary to kill ants would dissolve readily in the amount of liquid present in fresh beef. For his own work he had not even considered this poison as being commercially practical, on account of its cost, but suggested that the small amount necessary for carrying out the preliminary experiments might be obtained from the Ore and Chemical Corp., 40 Rector St , New York City. Eventually, after some delay, for the poison had to be specially ordered and imported from the factory in Germany, an ample amount for experimentation was received thru the courtesy of this company. In the meantime, however, the experimenter had been transferred to Río Piedras, in the near vicinity of which no hormiguilla infested trees are available for conducting experiments. After vainly examining numerous guaba and guamá trees, it was finally decided to use the historic jagüey tree in the Ciales valley near Manatí, for, in the course of the years which had elapsed since the close of the experiments with meat and cyanide on this tree, the colonies of hormiguilla had again become populous.

The first tentative application of a freshly prepared mixture of about a third of a pound of hamburger steak and two or three grams of thallium acetate on the trunk of this jagüey tree was made on August 4, 1932. The ants swarmed out to feed on the meat with

their accustomed eagerness, and apparently were unaware that it had been mixed with a most powerful poison. To test their perception of the presence of the poison, an additional amount was dusted on the level portion of one bit of meat where they were feeding, and even while it was dissolving in the meat juices, the ants continued to eat.

At the time the application was made, the sun was shining brightly, and the trunk of the tree was dry, but a few hours later the sky became overcast, and during the afternoon and following night several showers fell. None was of sufficient size or duration to get more than a part of the trunk of the tree wet, and when examination was made the next day at noon, it was found that one effect of the rain had been to keep the meat from drying out, and many ants were still feeding on it. Some of the bits of meat had been fashioned into shelves, because the experimenter had become accustomed to moulding them into this shape when cyanide was mixed with the meat, and on these shelves, numerous dead ants were to be seen.

The second application of half a pound of steak and five ounces of thallium acetate was made three weeks later on this tree, in many cases on top of the dry remains of the meat applied previously, but also further around its enormous trunk. The ants came to the meat eagerly, but not in such large numbers on the part of the tree previously treated. A third application was made between two and three weeks later, ants still being numerous on all parts of the trunk. Ten days later a fourth application was made, and it was then for the first time noted that the ants were not especially numerous, and seemed not especially eager to eat the meat. The hurricane of San Ciprián occurred on September 26–27, 1932, and no opportunity to visit the jagüey tree was available until October 20th. Some of the larger branches of the tree, amounting to possibly a third or a fourth of its bulk, had been broken off by the hurricane, but the trunk was uninjured, and many of the larger branches and small twigs were intact. Very few hormiguilla were to be seen, and even when fresh, unpoisoned meat was placed on the trunk, no ants came to it. The remainder of half a pound of steak was poisoned and applied in the usual manner, mostly in new locations, but this brought out only a few ants. Of course, the hurricane by blowing away so many branches had considerably decreased the ant population of the tree, but this decrease would be only approximately in proportion to the amount of the branches so removed. By comparison with the number of ants present two months previously, a conservative estimate was that

99 per cent of them were gone, and most of this was undoubtedly due to the thallium acetate.

The tree was later examined on November 30th, and while the trunk was still entirely free from ants, a considerable number could be found in the tips of twigs, in the part of the tree most distant from the trunk, where the poison had been applied. That the ants should have thus persisted in the tree indicates the difficult nature of the problem of hormiguilla control, for the ant population of a large tree consists, not of a single large colony, but of a large number of separate colonies, not sharply delimited, but each having communication only with its immediate neighbors. All the needs of the members of these colonies are supplied by resources close at hand, and apparently those inhabiting the twigs have little or no intercourse with those on the trunk. Nevertheless, the experiment indicates that commercial control of the hormiguilla: reducing the number of these ants present on the shade trees to such an extent that they do not overflow to the surrounding coffee trees, is now in sight.

How practical control by means of a proteid mixed with thallium acetate will be, how it will work out in practise in coffee groves, and how long such control will be effective, are points yet to be determined. Experiments were promptly started in coffee groves, but the Station at Río Piedras is most unfortunately located for initiating, continuing and observing such work in coffee groves, and the actual operation has necessarily been turned over to the Agents of the Extension Service who are located in coffee regions.

The three most important factors in determining the adoption of any method of insect control are: (1) non-injuriousness to host, (2) effectiveness, and (3) cost. In thus analyzing the value of the thallium acetate meat bait mixture for hormiguilla control, it should be noted that thallium is poisonous to vegetation as well as to animal life, but in the small amounts used, no effect at all has been noted either on the trees on which it was applied, or on the surrounding vegetation. Effectiveness appears to be close to perfection, altho it is yet much too early to say anything about permanence. The third factor—cost—is unquestionably high in the present stage of development of this method of control, but may be very considerably reduced as cheaper and more desirable substitutes for fresh hamburger steak, and simpler methods of application are devised. The poison itself is admitted expensive, but such minute quantities are needed that it is not the major item in total cost. Indeed, in these experiments, the steak at 18 cents a pound was more

expensive than the thallium that was mixed with it. Thallium sulfate is now extensively used in California and Hawaii in rodent control, and in south Texas in ant control, and it is only a third cheaper than the acetate. The present price of thallium acetate is something under $11 per pound in hundred pound lots, or a little over two cents a gram. Up to the present there has been no commercial demand for it, but if other uses for it are developed, this price may be somewhat reduced. It is quite possible that even smaller amounts per treatment would be effective if the poison could be more thoroly mixed with the bait. A uniform mixture would be ensured by the use of a meat jelly, semisolid at ordinary temperatures, but liquid at the higher temperature at which the solution of the poison is added. By the addition of other substances, the jelly could be given other desirable qualities: greater adhesiveness and less tendency to dry out rapidly after application, or to spoil if not used immediately.

SUMMARY

1. Under local conditions, experiments have indicated little value for thallium compounds and mixtures against the hormiga brava, *Solenopsis geminata* F., out-of-doors. In-doors, the thallium sulfate syrup has been just as uniformly successful as out-of-doors it is a failure. An emulsion of crude carbolic acid, either alone or mixed with kerosene emulsion or the engine oil emulsion sprays used for scale control, is still the cheapest and most effective insecticide to use against this ant in citrus groves, pineapple plantings and vegetable gardens.

2. Against the hormiguilla, *Myrmelachista ambigua ramulorum* Wheeler, a bait consisting of ground meat and thallium acetate is very effective, and gives promise of being adopted commercially when cheaper and simpler methods of application are devised.

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THE LIMA BEAN POD-BORER CATERPILLARS OF PUERTO RICO

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The three species of pod-boring caterpillars which attack lima beans in Puerto Rico constitute the greatest obstacle to the profitable production of this crop. Thus, an economic study of these caterpillars has been one of the main entomological projects at the Isabela Sub-Station ever since lima beans were planted there. Careful and detailed observations were made there on beans planted in the late spring of 1931, to determine the relative abundance of the caterpillars in different varieties of beans. On beans planted in the fall of 1931, comparable observations were made on their relative abundance in fields sprayed with Bordeaux mixture and magnesium arsena e, and in fields that were not sprayed at all. On beans planted in the spring of 1932, observations were made on sprayed and unsprayed beans, and on proximity to alternate hosts of the caterpillars. In an extension of this spraying and alternate host experiment, to which was added treatments with nicotine and pyrethrum, on beans planted late in the fall of 1932, final results have just been obtained. As the net result of these observations and experiments, it can now be definitely stated that no method of control of these pests is known. Indeed, all those suggested as likely to result in at least partial control are found by experiment to be valueless. Before considering the experimental evidence in detail, however, it may be desirable to give a general discussion of the insects, and especially of distinguishing characters of the three species of caterpillars and their habits as affecting the possibility of control by any of the means at present in common use.

The term "pod-borer" refers to the habit of these caterpillars of entering the pod when they are very small, and thereafter feeding entirely within the pod, remaining there thruout their larval existence, and sometimes pupating there. The female moths lay their eggs singly on the flower sprays, and the young caterpillars on hatching feed on any of the floral parts. Many of the buds which drop, some of the flowers which drop without setting pods, and most of the young pods which drop, fall from the vine because they have been more or less injured by the feeding of these small caterpillars. The

initial losses caused by these caterpillars are especially obvious at the beginning of the crop, when the ground under the vines will be strewn with buds, flowers and young pods which have served as food for the young caterpillars.

When the pods get to be a little larger and firmer, however, they do not fall from the vine when one of these caterpillars begins to feed, but are thick enough so that the caterpillar burrows right up inside of the pod. As the caterpillar continues to feed inside, and the pod continues to grow, a callus is formed where the caterpillar burrowed in, effectively closing and entirely concealing the point of entrance. So far as one can see by looking at the outside, the pod is perfect. Yet actually the caterpillar continues to feed inside, sometimes confining its activities to only one bean, altho often it chews into two or even three. While the caterpillar is still actively feeding and growing, ordinarily there is no external indication of its presence, but by the time that it approaches full size, its excrement has begun to rot and show thru the pod walls. Thus the infested pod is ruined from the standpoint of marketing, and is discarded when the beans are being sorted for shipment.

All of these injuries mentioned tend to reduce the total production. Quality is also affected, however, when pods ready for shipment contain small caterpillars, for these caterpillars continue to feed and grow while the beans are en route to market. Even if their presence is not apparent when the green beans are sold, the ultimate consumer preparing the beans for cooking is disgusted to discover that they are wormy, and is prejudiced against buying green lima beans in the pod again. Of course no one individual caterpillar can possibly cause all of these described types of injury, but different individuals of each kind of caterpillar cause each one of all these types of injury.

From the standpoint of extensive distribution and of quarantine restrictions at present in force, *Maruca testulalis* Geyer, a Pyralid-Pyraustinid caterpillar, is of the greatest importance. It is present in Japan and many other regions of the old world, but only in Cuba and Puerto Rico of the new world, and specifically not in the United States. For that reason, since July 1, 1925, no beans in the pod can be exported from the West Indies to the United States, except during the winter, and only under special permit and inspection, thus to a considerable extent limiting production in the West Indies. Incidentally, these restriction have been responsible for an intensive study of this insect in Cuba, where it is the most common pod-boring caterpillar. In Puerto Rico, *Maruca* is of only minor importance,

not because it is less abundant than in Cuba, but because two other species are so much more abundant and cause much heavier losses.

All the general statements made regarding pod-borer caterpillars do not apply exactly to *Maruca*, for the caterpillars after burrowing into the pod, have the habit of keeping an exit open to the outside, thru which to void their excrement. This habit is also of value to the bean grower, for he is thus able to make sure of all infested pods, and eliminate them as culls when green beans are being prepared for shipment for distant markets. Of course it does not lessen the injury caused by the caterpillars, but at least the shipper can be sure that

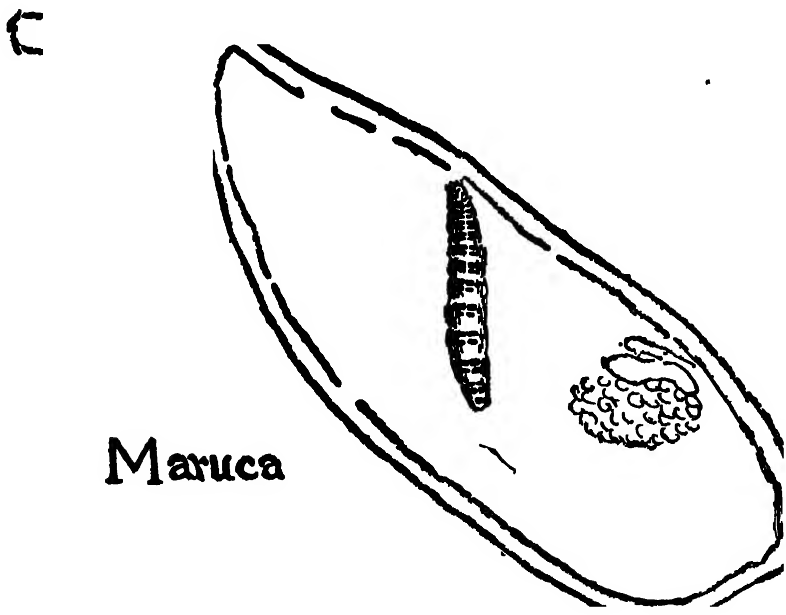

FIG. 1. Caterpillar of *Maruca testulalis* Geyer in small pod in which it has eaten all the beans. About twice natural size. (Original).

he is not sending out infested pods which will rot en route, or arrive in the kitchen of the housewife wormy and disgusting.

Maruca caterpillars are generally of a creamy white, and can most readily be distinguished by their spotted appearance, for they have four large black or dark grey spots on the back of nearly every segment. Sometimes the spots are not very dark, but usually they are quite distinct, and coupled with the presence of a frass-disposal hole to the outside of the pod, one can usually identify the caterpillar without difficulty. When fully grown, the caterpillars are two-thirds

of an inch long, and are then about to leave the pod where they have been feeding. They spin cocoons almost anywhere outside of the pod, or at times, even inside a dry pod, but usually their cocoons are found between pods, or on bean hampers, or in trash on the ground, and only rarely at any great depth in the ground itself. The moth is very active, and when not flying about, stands with wings outspread and all ready to go. The forewings are chocolate brown, with a large white triangular spot on the front margin, and the hind wings are silvery white with a brown spot at the corner more distant from the body.

Parasites of the caterpillar have been reared in Cuba, but are not abundant, and are a very minor factor in checking the numbers

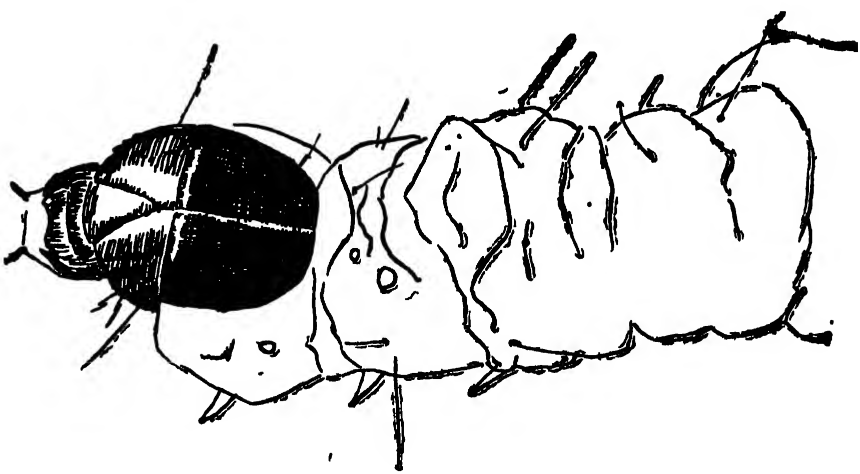

FIG. 2. Head and fore part of body of the caterpillar of *Fundella cistipennis* Dyar. About twenty times natural size. (Original).

of the pest. Spraying with Bordeaux has no effect on the amount of infestation, and about all that growers can do is to hand kill all the caterpillars that crawl out of the pods while they are being packed for shipment, and to destroy the culls. Experiments in Cuba have shown that the caterpillars in the pods can be killed by maintaining the pods for an hour in moist atmosphere of 44° to 46° C., or by fumigating with carbon bisulfid for two or three hours. By such means, wormy beans may be prepared to meet quarantine restrictions, and shipped to northern markets if a temporary scarcity of fresh beans warrants. From the standpoint of maintaining standards, however, a more careful inspection and culling out of all worm-in-

fested pods is much more satisfactory, even tho in special instances it may not be so immediately profitable.

The two more abundant species of pod-boring caterpillars in Puerto Rico are: *Etiella zinckenella* Treitschke (known in California as *E. schisticolor* Zeller) and *Fundella cistipennis* Dyar. Both insects belong to the same sub-family of the Pyralidae: Phycitinae, and in their larval stage are almost indistinguishable. Yet obvious differences do exist, and in Puerto Rico one caterpillar attacks lima beans only during the winter time, when they are being shipped to northern markets, while the other occurs in abundance only during the spring, summer and fall, when no shipments can be made on account of quarantine restrictions, and thus from the standpoint of the export grower is not an economic pest at all. In their earlier

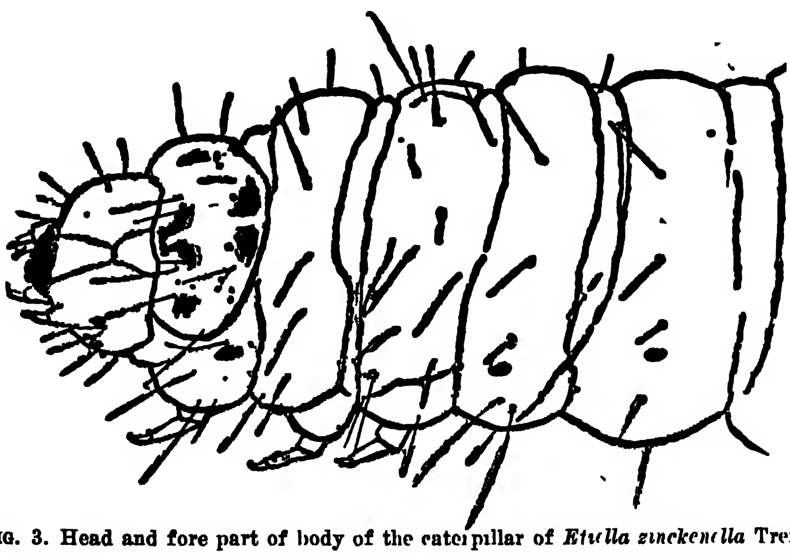

FIG. 3. Head and fore part of body of the caterpillar of *Etiella zinckenella* Treit., showing pattern on thoracic shield. About twenty times natural size. (Original).

instars, the caterpillars are indistinguishable by any gross structure, color or marking, both being light green in color, with a dark brown or black head and thoracic shield In the last instar, many of the caterpillars as they approach full size become purplish above, altho others (of both species) become more yellowish and creamily opalescent. Both are cylindrical in shape and in size approach *Maruca*, two-thirds of an inch long.

Their heads (in both species) vary in depth of coloration from a light yellow to a dark brown, but the thoracic shield, just back of the

head, furnishes the clue to specific identification. The thoracic shield of *Fundella cistipennis* is of the same color as the head, or possibly a little darker, unmarked, or with the markings scarcely visible because of the dark color of the entire shield, or with the markings distinct but vaguely outlined and of a variable pattern. By contrast, the thoracic shield of *Etiella zinckenella* is invariably opalescent greenish-yellow, marked with a very definite pattern in black; two confluent crescents in the center forward, two broader ones to the rear, and a mark on each side, together with several pairs of small black spots, the four larger anterior marks being in sharply sculptured depressions. This sounds complicated, but, in practise, after one has seen both kinds of caterpillars at the same time and made the comparison, the difference is thereafter unmistakable.

Under normal conditions, the tough, grey cocoons of both species of caterpillars are made at a considerable depth in the soil, those of *Etiella* at a considerably greater depth than those of *Fundella,* but not in hampers or in trash in the surface of the ground as are those of *Maruca.* Adults emerge within a couple of weeks.

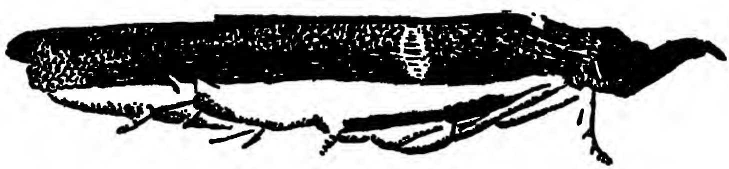

Fig. 4. Moth of *Etiella zinckenella* Treit. About eight times natural size. (Original).

The adult moths of both species when at rest keep their wings tightly folded around their abdomen, very different from the outspread wings of *Maruca*, apparently always just about to fly away. Otherwise than in the manner of holding their wings while at rest, the two species are not similar in appearance, for the forewings of *Etiella* are broadly margined with silvery white, these margins blending with the white of the legs and abdomen when the moth is at rest. Its large palpi stick out like a beak in front. The moth of *Fundella cistipennis* is of a characterless, inconspicuous greyish-brown, with no marked or well-defined pattern on the wings, but with the interesting habit of often keeping the ends of its antennae underneath its folded wings.

As regards other hosts than lima beans, the months show a most surprising difference in those on which they oviposit. During warm weather, *Etiella* caterpillars, somewhat dwarfed and dried-up in ap-

pearance as compared with the plump, juicy larvae occurring in lima beans, and longitudinally striped with purple, are quite common in the pods of *Crotalaria incana*, and in no other species of this genus of plant. Observations on this selection of host plant were made independently by two entomologists in Cuba (L. Dean Christenson & S. C. Bruner), and are confirmed by observations made by the writer in Puerto Rico. On the beach at Mameyes, EVERY mature pod of several bushes of *Crotalaria incana*, observed in mid-summer, was infested. Thruout the year, *Fundella* caterpillars are to be found attacking the pods of sword beans and beach beans, *Canavalia ensiformis* and *C. maritima*, often causing much more obvious external injuries than they do to the pods of lima beans. Sometimes as many as 3 or 4 caterpillars may occur in a single pod. (See plate XIX). (*Maruca* caterpillars are also often found in sword bean pods, their abundance in this host in Puerto Rico considerably

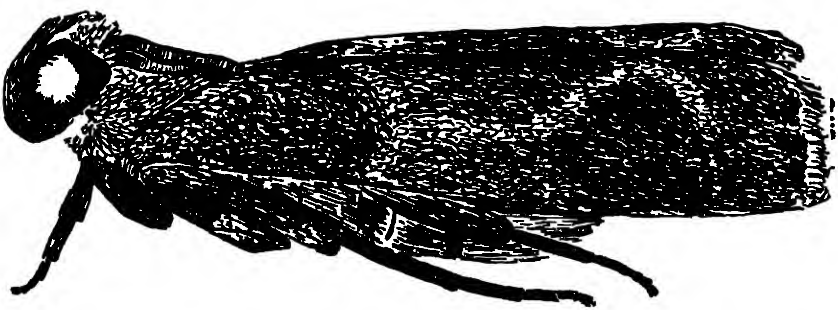

FIG. 5. Moth of *Fundella cistipennis* Dyar. About ten times natural size. (Original).

exceeding that in lima beans). *Fundella* caterpillars also burrow in the stems of cowpeas and attack the young shoots and buds.

The range of these two such similar yet divergent species overlaps only in Puerto Rico, so far as is known. *Fundella cistipennis* was originally described as *Ballovia* from Barbados, and has since been found in St. Vincent, St. Croix, Vieques, Puerto Rico and at Port-au-Prince, Haiti. *Etiella zinckenella* is of cosmopolitan distribution, being reported from many European and Asiatic localities, Colombia in South American, and from many places in the United States, altho it is an economic pest only on the Pacific coast. In the West Indies, it occurs only in Cuba and Puerto Rico.

The reported scarcity of *Etiella zinckenella* on lima beans in Cuba is presumably largely due to the fact that this crop is grown there only for export during the winter. In Puerto Rico, *Etiella* is equally

scarce during most of the shipping season, but in experimental plots of beans planted during the late spring, it becomes very abundant, often attacking from a fourth to a third of all mature pods. During the winter, when lima beans in the pod may legally be shipped to the United States, practically no *Etiella* caterpillars occur, their place being taken by smallers numbers of *Fundella,* and in lima beans grown at the higher elevations, a few *Maruca* caterpillars in addition.

The first counts made of pod-borers at Isabela will serve to indicate the prevalence of *Etiella* in the late spring, altho they were primarily intended to determine the relative infestations of the caterpillars in different varieties of beans. These observations were made in a field planted on Feb. 26, 1931, in which, after the first month, the plants were sprayed every ten days with Bordeaux mixture. The purpose of the planting was to obtain data on yields, but was also available to the writer for examination as to infestation of the pods by caterpillars. The plot was small and samples of each variety of only 25 pods were examined. At the time the examinations were commenced, the characters distinguishing the three kinds of caterpillars were not known, and it is merely presumed that most of the caterpillars observed at first were *Etiella zinckenella,* as all of them were known to be after the first four observations.

PER CENT OF INFESTATION BY POD-BORER CATERPILLARS

Average of the variety	Variety	April 30	May 6	May 16	May 20	May 28	May 30	June 5	June 11	June 12	June 19	July 2	July 20	August 28
12	Challenger	8	20	8	16	0				8	24			
13	Carpentera	12	24	20	12	0				16	8			
9	Burpee	30	4	4	8	0								
18	Fordhook	44	32	16	8	0								
9	Average	23	20	12	11	0	3	0	5	12	16	6	15	0

On another field of Challenger pole beans planted at about the same time, at Maleza, near the Agujereada light-house, the infestation by *Etiella* on June 9, 1931 was total, many pods containing two or three caterpillars. By June 30th, it had dropped to 36 per cent infestation, and was 46 per cent on July 20th. In explanation of the great difference in infestation, as compared with the field at Isabela only five or six miles away, it should be stated that infestations are usually very heavy at the beginning of the crop, dropping off rapidly when production is really started.

On the drops from lima beans observed December 1, 1931, in a field of Challenger pole beans at Isabela, sprayed weekly with Bordeaux and magnesium arsenate, the infestation was more than total,

Etiella caterpillars being fifteen times as numerous as ***Maruca***, and no ***Fundella*** caterpillars present. Ten days later, on drops in the same field, most of the caterpillars were ***Fundella***, some were ***Etiella***, and a few ***Maruca*** were found. This field did not come into full production until the latter part of December, at which time comparison could be made with two unsprayed fields nearby of the same variety. All of these fields were in commercial production, consequently only cull pods were available for examination.

The cause of rejection varied considerably, being much more numerous in the unsprayed fields on account of spotting by ***Elsinoe***, or injury by the leaf-folder caterpillar, ***Lamprosema indicata*** F., both of which were largely controlled in the sprayed field. Thus the frequency of infestation by pod-borers in the culls from the sprayed field appears much higher, altho it might not vary greatly from the unsprayed fields if the total crop could be sampled. Whenever possible, samples of 100 or 200 pods were examined. The records are given in the following table.

INFESTATION OF POD-BORER CATERPILLARS IN LIMA BEANS GROWN AT ISABELA, WINTER OF 1931-32

Date	Condition	*Fundella*	*Etiella*	*Maruca*	Caterpillar gone (or too small to identify)	Total
December 24	Sprayed	34	12	1		47
December 31	Unsprayed	14		1	10	25
December 31	Sprayed	14	2	2	13	31
January 6	Unsprayed	16			24	40
January 6	Sprayed	35		1	12	48
January 13	Unsprayed	5			20	25
January 13	Sprayed	9			7	16
January 20	Unsprayed	1			6	7
January 20	Sprayed	1			6	7
January 28	Unsprayed	1			7	8
January 28	Sprayed	1			6	7
February 3	Unsprayed	16				16
February 3	Sprayed	45				45
February 3	Unsprayed	9				9
February 10	Sprayed	18			37	55
February 10	Unsprayed	2			6	8
February 17	Sprayed	12		2	30	44
February 17	Unsprayed	1		1	1	3
February 24	Sprayed	16		2	26	44
February 24	Unsprayed	4			7	11
March 2	Sprayed	1	1		8	10
March 2	Unsprayed	1			3	4
March 9	Sprayed	13	1	1	25	40
March 9	Unsprayed			1	5	6
March 16	Sprayed	6		4	18	28
March 16	Unsprayed				6	6
March 23	Sprayed	3		7	25	35
March 23	Unsprayed	4	1		5	10
March 23	Unsprayed	2	1		5	8
March 31	Sprayed	3	2		17	22
March 31	Unsprayed	5	4		3	12
April 6	Sprayed	7			21	28
April 6	Unsprayed	2	4		13	19
May 5	Sprayed		1		7	8
May 10			2		4	6
Total		301	31	23		Average 21

The absolute disappearance of *Etiella* during January and February is well shown in the above record of counts, and its scarcity during March. During the entire period, not a tenth as many *Etiella* caterpillars were noted as of *Fundella*, and *Maruca* was even less abundant. The average infestation appears considerably higher during the winter than in the spring, but it must be remembered that only culls were examined during the winter, while representative samples were available for examination from the previously observed late spring crop.

A part of one unsprayed field observed during the winter had sword beans interplanted between every five rows of lima beans, and a row of *Crotalaria incana* along one side. The *Crotalaria* did not begin to have pods until early in March, consequently no observations could be made on whether the insect passed the winter months on this (supposedly) preferred host, rather than on lima beans. No caterpillars were noted in these pods until the latter part of March, when lima beans were also beginning to be infested. On March 24th, several hundred *Crotalaria incana* pods were available for examination, of which only 2 or 3 per cent were infested by *Etiella*. On April 5th, 200 pods were examined and 15 per cent were found to be infested. In only a few cases were caterpillars present, but the indications of their former presence were unmistakable, a webbing together of the seeds, quite different from the clean injury caused by the larvae of *Utethesia ornatrix*. The *Etiella* caterpillars in *Crotalaria* have quite a different appearance from those which have fed on lima beans, having a shrunken, shriveled look, are more bluish-green in color and invariably have four longitudinal purplish-chestnut stripes running along the back. On May 12th, 444 pods were available for examination, and of these 18.5 per cent were, or had been, infested by *Etiella* caterpillars.

The sword beans also, altho planted at the same time, did not begin to come into production until several weeks after the lima beans were bearing heavily, and were as heavily infested by *Fundella* caterpillars as were the lima beans. Indeed, at no time were many sword beans attacked by either *Fundella* or *Maruca*, and, reviewing the observations now, it becomes apparent that sword beans can be of little value in attracting the moths away from the lima beans unless planted several weeks or a month in advance. Heavy infestations of these caterpillars in sword beans have been observed to occur only when the sword beans came into production at about the time the adjacent lima beans ceased to have many pods.

Out of all the hundreds of caterpillars collected, only one *Fundella*

was observed to be parasitized. It bore four globular, semi-transparent, greenish maggots attached to one side, which increased rapidly in size, becoming fully grown on the day after the drawing (See Fig. 6) was made, spinning cocoons of grey silk by the next day, and appearing as ant-like adults ten days later. These wasps were identified by Mr. A. B. Gahan as *Perisierola* sp., probably *cellularis* (Say).

As explained in a previous paragraph, the lima beans examined during the winter of 1931–32 were only culls. From such inspections it was impossible to determine whether spraying with Bordeaux and magnesium arsenate had any effect on the pod-boring caterpillars, or not. From a casual inspection of the returns, it would seem the caterpillars were more abundant in the sprayed beans, and it appeared possible this might not be merely the appearance, but the reality. Spraying might cause the small caterpillars to burrow into the pods earlier than they otherwise do normally, thus actually de-

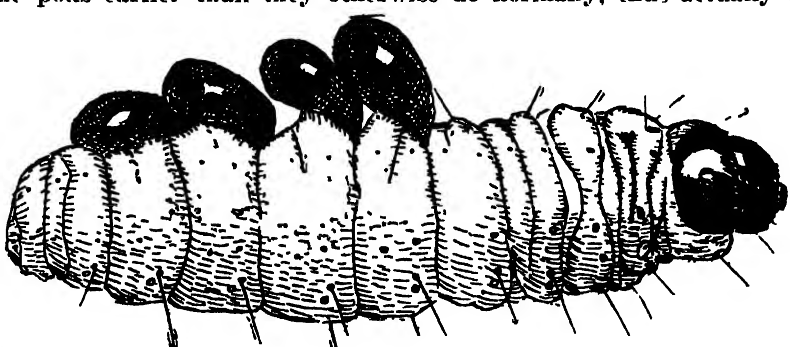

FIG. 6. Caterpillar of *Fundella cistipennis* Dyar parasitized by maggots of *Perisierola* prob. *cellularis* (Say). About fifteen times natural size. (Original).

creasing the number of deaths due to predators and other accidents befalling them while feeding outside of the bean tissue. To more definitely determine the value, or otherwise, of spraying, a specific experiment was conducted during the late spring of 1932. The plan of this experiment was as follows:

1. *Crotalaria incana* (1 row)
2. *Canavalia ensiformis* (2 rows)
3. Lima beans—untreated (3 rows)
4. Sprayed weekly with Bordeaux mixture, 2–2–50 and Magnesium Arsenate (3 rows)
5. Sprayed weekly with Bordeaux only (3 rows)
6. Check (3 rows)
7. Sprayed with poison only, 2 pounds in 50 gallons water (3 rows)

8. Check (3 rows)
9. Sprayed with Bordeaux & poison (3 rows)
10. Check (3 rows)
11. Poison only (3 rows)
12. Check (3 rows)
13. Bordeaux only (3 rows)
14. Bordeaux & poison (3 rows)
15. Untreated (3 rows)
16. *Canavalia ensiformis* (2 rows)
17. *Crotalaria incana* (1 row)
18. *Canavalia ensiformis* (3 short rows)

The seed was planted March 3, 1932, and two weeks later both kinds of beans were up, the lima beans having second and third leaves on. The *Crotalaria* shoots had not yet appeared at this time, and indeed germinated so poorly that, for the purposes of the experiment, their presence may be disregarded. It should be noted that the experiment repeats itself in the reverse order, so that Untreated 3 and 15 are comparable, being beside alternate hosts, while the other untreated rows are true checks, being between sprayed rows. The beans from all comparable treatments were combined for selecting samples for examination, and, so far as possible, these consisted of 100 marketable pods. The first samples were received on June 7th, the last on July 19th. Neither *Maruca* nor *Fundella* caterpillars were found in any beans, all caterpillars being *Etiella zinckenella.* It should be especially noted that these infestations were not in cull beans, nor in run of the field but, in selected, and apparently marketable beans The extremely high infestation by *Etiella,* does not, however, indicate that this insect is a serious pest of lima beans grown for export to the United States, for these beans were grown during the summer, when no green beans in the pod can be shipped.

SPRAYING EXPERIMENT FOR THE CONTROL OF LIMA BEAN POD-BORER, (*ETIELLA ZINCKENELLA* TREIT), SUMMER OF 1932, AT ISABELA, PUERTO R[illegible]

Average	Treatments	June 7	June 15	June 22	June 29	July 8	July 1[illegible]
31	Untreated, beside sword beans	40	20	24	41	38	2[illegible]
40 5	Untreated check	49	29	35	40	50	4[illegible]
31 6	Sprayed with Poison only	37	27	32	20	39	26
36	Sprayed with Bordeaux only	44	34	27	36	47	29
48	Sprayed with Poison and Bordeaux	53	46	47	26	66	49
	Average Examination	45	31	37	34	48	34

Several of the *Etiella* caterpillars collected in these examinations were parasitized by maggots similar in general appearance to the ones previously observed on the *Fundella* caterpillar, but in color a dull pinkish. They developed with similar rapidity, but spun tough

brownish cocoons, the adults emerging ten days later being quite different in appearance. These wasps were identified by Mr. C. F. W. Muesebeck as *Heterospilus etiellae* Rohwer.

The results of this experiment are not especially convincing, for the presence of *Canavalia* beside the unsprayed rows could have no possible effect on the infestation of the lima beans by *Etiella*, as sword bean is not normally a host of this caterpillar. (It should be mentioned that these sword beans were infested by *Fundella* caterpillars, even tho none occurred in the lima beans). It would, however, tend to indicate that the less one sprayed, the better, and certainly could be interpreted to mean that any expense for spraying could not be justified on the basis of its value in the control of pod-borer. The most serious criticism of the experiment, however, is that it deals entirely with the one pod-borer which does not ordinarily affect the beans grown in the winter for export. For practical purposes, the grower is concerned with *Fundella*, and with *Maruca* only as an unusual abundance may affect the possibility of meeting quarantine requirements, but with *Etiella* not at all, because it is not subject to quarantine, and also because it is so scarce in lima beans grown in the winter. Yet this experiment, conducted during the summer, concerned only *Etiella*.

To meet all of these criticisms, if possible, another experiment was planned, to be conducted during the winter, producing lima beans at the time and under the conditions affecting commercial growers. As one grower, whose statement was quoted and given considerable publicity by one of the companies marketing extracts of pyrethrum, claimed to produce lima beans that had no difficulty in being passed by the quarantine inspectors on account of infestation by pod-borers (whatever that claim might mean), pyrethrum was added to the substances tried. The only possible value for any insecticide in the control of any of these pod-borers would be in killing the eggs or the small caterpillar before it had entered the pod. To kill such minute caterpillars, a contact insecticide might be as valuable as a stomach poison, thus a trial of nicotine sulfate was added to the experiment. The Nicotrol (nicotine sulfate plus penetrol) used was contributed by the Kay Fries Chemicals Inc., and the pyrethrum, in the form of "Pyagrol", by John Powell & Co., to which firms the writer is thus indebted. The plan of the experiment is as follows:

1. *Canavalia ensiformis* (3 rows).
2. Untreated (3 rows).
3. Weekly spraying with Bordeaux mixture, 2–2–50 and Magnesium Arsenate, 2 pounds to 50 gallons of mixture (3 rows)

4. Bordeaux only (3 rows)
5. Check (3 rows)
6. Bordeaux plus "Nicotrol" (Nicotine Sulfate and "Penetrol") 1 part to 200 of liquid (3 rows)
7. "Pyagrol" (Pyrethrum plus "Penetrol"), 1 part to 200 of water (3 rows)
8. "Pyagrol" (3 rows).
9. Bordeaux plus "Nicotrol" (3 rows).
10. Check (3 rows)
11. Bordeaux only (3 rows)
12. Bordeaux & Magnesium Arsenate (3 rows)
13. Untreated (3 rows)
14. *Canavalia ensiformis* (3 rows)

Seed was planted on November 18, 1932, and weekly spraying commenced as soon as the first bloom appeared, about two months later. The first samples, 100 pods, unselected, from each series of rows, were received on February 20th, 1933, and as the experiment was being conducted in reversed duplication, were combined to form samples of 200 pods from each treatment. The sixth lot of samples, received March 27, consisted of the total production for that week, but was insufficient to make up the total number of the other samples. Production practically ceased for a time thereafter, but the seventh shipment, April 20th, was of the required number. The experiment was conducted in Isabela, but examinations were made at Río Piedras on the day after picking.

SPRAYING EXPERIMENT IN THE ATTEMPTED CONTROL OF THE LIMA BEAN POD BORER CATERPILLARS *FUNDELLA CISTIPENNIS* DYAR *ETIELLA ZINCKENELLA* TREIT. *MARUCA TESTULALIS* GEYER, CONDUCTED AT ISABELA, PUERTO RICO, WINTER AND SPRING OF 1933

Dates	Number of Caterpillars per 100 Pods (Samples of 200)									
	Feb 20	Feb 27	March 6	March 13	March 20	March 27	April 21	April 29	May 10	May 20
Treatments										
Beside *Canavalia*	2 5	6 0	4 0	2 5	6 0	7 1	3 5	1 5	9 5	17 5
Bordeaux & Mg Arsenate	5 0	4 0	2 5	4 5	4 0	5 0	1 0	6 0	5 5	10 0
Bordeaux only	3 0	5 0	2 0	4 0	4 0	6 3	1 5	3 5	5 0	11 0
Check	3 5	10 0	5 0	4 0	5 0	3 7	4 0	4 5	4 5	14 0
Bordeaux & Nicotrol	2 5	4 0	6 0	5 0	3 5	1 4	5	2 5	3 5	8 0
Pyrethrum	1 5	1 5	5 5	3 5	4 5	3 2	1 5	3 5	5 5	6 5
Average	3 0	5 1	4 1	4	4 5	4 5	2 0	3 6	5 6	11 3
Total Caterpillars Identified each examination.										
Fundella . .	19	23	20	7	18	5	3	0	2	6
Etiella	0	0	1	3	2	2	1	8	16	60
Maruca	1	4	0	1	0	0	1	1	0	0

The first two examinations appeared to indicate that the caterpillars were being controlled in the rows sprayed with pyrethrum.

Most unfortunately, later pickings failed to show any advantage from the use of this extract, and indeed sprays with other substances gave even lower infestations during some later weeks. Of course it is possible that the use of pyrethrum at greater strengths, or oftener, might give complete control, but it is doubtful if such treatments would be commercially practical. Thus the experimental evidence, to date, indicates no method of control for the lima bean pod-borer caterpillars.

The final experiment, valueless from the control standpoint, is most interesting otherwise in indicating just when *Fundella* caterpillars cease to be abundant in the spring and their place is taken by much greater numbers of *Etiella*, fully a month after shipment to the States has been discontinued on account of quarantine restrictions.

THE LARVAL PERIOD OF DIAPREPES ABBREVIATUS L.

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In proportion to its economic status, the weevil root borer of the West Indies, *Diaprepes abbrevictus* L., (=*spengleri* L.) has received surprisingly little careful study. Most of our information regarding the insect has been confined to the period of its aerial existence; what happens to the subterranean forms is for the most part inferred rather than known. The exclusively aerial adults, large weevils striped with black and white or bright colors, feed on the tender leaves of many kinds of trees and plants. Clusters of from ten or a dozen to several hundred oval eggs are laid between two older and tougher leaves glued together, hatching of the grubs occurring in six to ten days. The grubs do not burrow thru the leaf, all such holes being made by the wasp parasites, but wiggle out from between the leaves, dropping at once to the ground, into which they burrow. From the beginning, they feed only on live vegetable tissue, so far as known attacking all kinds of plant roots with impartiality. After a larval period presumed to occupy most of a year, pupation occurs in a cell at some depth in the earth. The pupal period is short, about fifteen days according to all observers Some time may be spent as adult in the pupal cell, but once the adults have emerged from the earth, they never again return to it.

Injury to economic plants is caused by both larva and adult, citrus trees and sugar-cane being most often attacked. In Barbados, the insect is practically restricted in all host relationships to sugar cane: the adults feeding on the leaves, the females laying eggs between the split tips of the leaves, the young grubs feeding on the roots, the older grubs burrowing into the root-stalk, and the pupa often being formed in a cavity in the cane stool. Elsewhere the adults feed on the leaves of many wild and a few economically valuable plants, and the grubs are apparently unrestricted in their choice of roots on which to feed.

The range of the insect is from Barbados to eastern Hispaniola, and over this range the adults differ so greatly in color markings and general appearance that numerous varieties and species have been described, all of which, we are assured by the systematists, belong to but a single species. The variation in the size, color and habits

of the adults may appear in the grubs as a variation in behavior and length of the larval periods, for regarding the latter, no observers agree. Over thirty years ago, that enthusiastic amateur entomologist, the Rev. N. B. Watson, in Barbados reared a few individuals from egg to adult and determined the larval period as being from 300 to 312 days. A dozen years later, Wm. Nowell in Barbados found 261 days, 326 days and 334 days as the length of time before pupation for rearing immatures grubs of small size. Judging by the few completed rearing records, the larval period in Puerto Rico may be considerably shorter. Three grubs only, out of the hundreds used in the experiments that have been conducted here in the past two years, have been successfully reared from the just hatched larva to pupa, the larval periods for these three grubs being 202 days, 238 days and 268 days respectively. (See Table, p. 259.)

All of the grubs have been carefully observed as to molting; the one attaining the pupal period in 202 days pupating from the 10th larval instar, the one pupating in 238 days having attained complete larval development in only six instars, while the one requiring 268 days to become a pupa changed from the ninth instar. From such a small number of individuals, no generalization of value can be made, and indeed one can not be sure that these individuals pupating in such a short period are not exceptional rather than normal individuals. Other grubs have molted to the 16th instar, in one case after only 220 days, while other individuals have lived over a year as larvae. Not one of these other grubs, however, has succeeded in evading the varied perils inherent in the more or less unnatural conditions attendant on artificial rearing and constant observation, and most of them have died before pupation. Unquestionably, all of these grubs were sound and healthy in their earlier instars, while they were growing rapidly and making constant gains in size and weight, but having attained maximum weight, they entered a period of inactivity and failure to eat, a cul-de-sac from which the only escape was not pupation, but death. A few of these grubs are still alive, but the stimulus which will cause them to continue their transformation is not yet determined. Admittedly the present paper is incomplete and essentially preliminary. While the completed rearing records may be considered as finished and final, all the general statements made are tentative, and subject to change as additional results accumulate.

The first year's rearing was conducted at Isabela, the second at Río Piedras, and despite the fact that the same type of container, the same cabinet for holding the rearing boxes, the same food and in

LARVAL PERIODS OF *DIAPREPES ABBREVIATUS* L SELECTED INDIVIDUAL RECORDS AND AVERAGES OF ALL RECORDS
DAYS AFTER HATCHING TO BEGINNING OF INSTAR

	Completed normally			Incomplete, died before pupation												Averages of All Records	
Reared at	Rio Piedras	Isabela		Rio Piedras						Isabela						Rio Piedras	Isabela
Instars / Date hatched	Sept 10	July 5	May 5	Dec 24	Oct 5	Sept 1	Aug 5	Oct 5	Aug 5	Jan 19	Nov 17	Oct 1	May 5	June 22			
2nd	12	31	27			12	10	10	17	31	23	8	11				28 34 grubs)
3d	21	38	33	23	19	21	20	20	29	59	41	18	32	32	89	21 (77 grubs)	46 (34 grubs)
4th	25	51	42	34	24	30	29	29	44	78	77	38	64	52	135	29 (82 grubs)	66 (38 grubs)
5th	33	145	57	39	33	35	41	41	57	103	94	106	92	101	163	37 (84 grubs)	100 (37 grubs)
6th	42	172	130	46	42	53	51	52	66	114	103	156	200	134	251	47 (82 grubs)	146 (34 grubs)
7th	82		153	53	49	62	63	73	110	124	132	185	219	163	305	62 (82 grubs)	184 (30 grubs)
8th	115		211	59	71	72	83	92	136	138	143	210	273	256	339	88 (88 grubs)	221 (21 grubs)
9th	128		227	81	101	86	103	114	166	167	183	280	316	305		117 (80 grubs)	262 (13 grubs)
10th	173			107	124	102	125	134	196	192	233	308	339	340		148 (68 grubs)	300 (6 grubs)
11th				130	141	123	148	145	225			355		361		170 (52 grubs)	
12th				161	159	142	166	152	246							195 (38 grubs)	
13th					202	156		156	263							218 (18 grubs)	
14th					217	177		171	285								
15th					227	191											
16th					239	220											
				Minimum to 8th instar	(Fed corn only)			(Fed b[illegible]s only)	Maximum to 8th instar for Rio Piedras	Minimum to 8th instar for Isabela					Maximum to 8th instar		
Pupa	2[illegible]	238	268														
Adult			289														

many cases the same soil were used in both localities, the grubs attained full size in a much shorter time at Río Piedras. The factors of difference, so far as known, are three. The grubs were examined every week at Isabela, but at Río Piedras they could be watched more carefully, examinations being made usually three times a week. The water used to moisten the soil at Isabela was taken from the irrigation ditch; that at Río Piedras was city water which often was heavily chlorinated. The mean minimum air temperatures at Río Piedras averaged two or three degrees lower than at Isabela during the winter only, otherwise they were practically the same. How this affected the soil temperatures is problematical. The speeding up to growth in Río Piedras applies also to the total larval period, for the minimum of 202 days was obtained here, the other two records being of Isabela grubs. It was not a characteristic of the grubs themselves, for some of the grubs reared at Río Piedras were from egg-clusters collected at Isabela, others were from Florida (between Arecibo and Barceloneta), only the minority being obtained locally.

Various sizes of tin salve boxes have been used as containers, but finally the two ounce size was adopted for all work as being the most desirable. The soil used was that most readily available outside the laboratory door, the only selection being to eliminate large sticks, stones or other debris, the earth particles carried up out of their tunnels by ants often being selected. At first, soil brought from Isabela was used at Río Piedras, until a considerable expansion of the experiment required additional amounts, which were picked up locally. In many cases, previously discarded soil which had been thoroly dried or baked was used in preference to obtaining fresh soil from the garden. Moisture was added by means of a medicine dropper, attempting to keep the soil reasonably moist at all times, and only excessively moist when seeds were to be sprouted.

As food for the grubs, corn only was used at first; later, fresh lima beans were added. As the lima beans were subject to rot, sword beans were substi uted, the usual combination placed in one box with a grub being two grains of corn and one bean. So far as could be determined, the grubs fed on the corn or beans with strict impartiality, and apparently throve equally well on either. To determine the effect of food on rapidity of growth, half the grubs from one egg-cluster hatching on October 5th were placed in cans supplied only with corn, the others in cans supplied only with sword beans.

In the first instar, the mortality was greater among the grubs supplied only with corn, so that only five survived, as compared with twice as many which lived to eat beans. Yet these five grubs eating corn averaged from two to fourteen days less time in reaching each instar up to the ninth. By the tenth instar, however, when all the grubs had ceased feeding, those which had previously eaten only sword beans molted nine days ahead of those previously eating corn. In the molt to the 11th instar, the corn-eating grubs were one day ahead, in the molt to the 12th, nine days ahead, yet in the molt of the 13th, their respective positions were again reversed, those which had eaten corn being three days ahead (214 days vs. 217 days). Such slight differences may be considered as due to individual variation, and indicate that no significance is to be assigned to food.

Extreme seasonal variation in abundance of adults has repeatedly been noted, yet adults are present at all times, and egg-clusters have been collected during every month of the year at both Isabela and Río Piedras. No special effort has been made to rear grubs from the eggs of every month, and indeed only minor differences are to be noted in rapidity of growth of the grubs during the warmest and the coldest months. It is possible that the grubs grow most rapidly during cooler (tropical) weather, and the majority of the rearings would appear to indicate this, yet so many individual exceptions are to be noted that it is by no means certain. Some grubs hatching from egg-clusters laid in December have attained maximum size in two months, or a little longer, but other individuals from the same cluster required as long, or longer, than grubs hatching out early in August. Individual variation is much greater than seasonal variation, some of the grubs from one large egg-cluster hatching in December requiring more than twice as long to make the same gains in size and weight as others from the same cluster. Some grubs are exceptionally slow in the earlier instars, others in the later growth instars, all from the same egg-cluster, and reared under as nearly as possible the same conditions. Inividual variation in rapidity of growth does not follow the normal curve, for the majority of grubs are close together, making rapid gains in size and weight with none greatly in advance, but the minority strings out almost interminably behind Some of the delayed minority may later catch up, or almost catch up with those which have made the most rapid growth at first, and others are permanently greatly delayed, yet they seem as healthy and normal as any others. (See Plate XX.)

No explanation can be given of the failure of some grubs to eat and grow as fast as others from the same cluster, more especially

when all were in the same container during the earlier instars. An abundance of food was available at all times, and the grubs were so active that they could hardly have failed to come into contact with it. Molting, however, at least during the earlier instars, is to some extent dependent on soil moisture, being inhibited when the soil is dry, but ensuing within a few minutes after a sudden access of water. Wm. Nowell is of the opinion (2) that pupation also normally follows spring rains after the comparatively dry winter weather of Barbados, but no pertinent observations on this point have been made in Puerto Rico.

The larval period of *Diaprepes* grubs falls into two parts: (1) a period of constant and rapid growth, extending from hatching to about the beginning of the eighth instar, during which time the head-size of each instar is noticeably different so that each instar may at once be recognized by examining the grub itself, and (2) a period of equal or even greater length when the size and weight of the grub remains constant, or tends to decrease, extending from the eighth instar, or earlier, to pupation, during which period the number of molts can be determined only by keeping track of the molted skins. In the first period, the grub is feeding most of the time, in the second it eats little or not at all. Some individual grubs in the second period molt almost as frequently as previously, but most of the grubs at much greater and very irregular intervals. Individual variation is even more marked than in the first period, and the problem of maintaining the grubs alive and healthy becomes increasingly difficult. So few of the grubs have successfully passed thru this period of inactivity under artificial rearing conditions that most of the data accumulated concerning it is admittedly false. It seems very improbable that under normal conditions it usually ends in the death of the grub. All the activities of the insect occupy less than half a year, but this long, indefinite and indeterminate waiting period of the larva before pupation stretches out the life-cycle so that it will fit into the seasonal pattern of a year. It suggests that the insect should be better adapted to a climate inducing a long period of hibernation or aestivation, altho the period does not, or may not, actually coincide with any extended period of temperature difference.

Regarding the first period of activity and rapid growth we can be much more certain that the data accumulated are reasonably correct. Grubs in both periods have been weighed during all instars, not the same individuals, but ten or a dozen individuals in each instar, and, with some minor adjustment of these averages, we can be reasonably certain that the majority of the grubs in this first period make

steady and constant gains in weight. To be sure, this steady gain is interrupted at every molt, for every molt results in a small temporary loss, but if one considers the gain from about the middle of one instar to the middle of the four succeeding instars, the resulting curve will be a straight line. Starting with the newly hatched larva weighing .000125 gr. each, in each of the succeeding five intervals of ten days, at Río Piedras, (from hatching to the middle of the first instar, from the middle of the first instar to the middle of the second, from the middle of the second to the middle of the third, etc., each one of which is approximately a ten day interval at Río Piedras) the increase in live weight is *four* times: to .0005 gr., to to .002 gr., to .008 gr., to .032 gr., to .128 gr. by the middle of the fifth instar. This is the period of most rapid growth.

Following it is a transition period of less rapid growth. From the middle of the fifth to the middle of the sixth instar,, the interval is no longer, but the increase in weight is only *three* times, to .384 gr. From the middle of the sixth to the middle of the seventh instar, the interval is one-half longer, to fifteen days, and the increase in weight is only one and one-quarter times, to .48 gr. Individual grubs may weigh considerably more than this in the 7th and later instars, the maximum observed for any grub being .74 gr. for one individual in the 9th instar. The average weight, however, of those in any of the later instars is .5 gr. or a little less Most grubs attain their maximum weight in the eighth instar. For most grubs, and for the average of all grubs, molting to the eighth instar marks the end of the period of growth and the beginning of the period of inactivity preceding pupation. At Isabela, the period interval between the middle of succeeding earlier molts, instead of being ten days as at Río Piedras, was fifteen days, and in addition to being one-half longer, began to lengthen earlier, to thirty days between the middle of the fourth instar to the middle of the fifth, and to forty days for the succeeding instars.

Up to the middle of the fifth instar, the grubs are of insignificant size so far as the damage they are capable of causing to the roots of plants is concerned, but the slowing down of their rate of growth coincides with the period when they are of sufficient size so that the result of their feeding activities is a very noticeable loss to the farmer. That they should grow so rapidly in the first two months results in no noticeable and obvious injury to well established plants, but their feeding in the next month results in the maximum injury they are capable of causing. This point is of the greatest practical im-

portance to farmers, especially those who are growing vegetables between young citrus trees for instance. The appearance of large numbers of adult beetles feeding on the tender leaves of their citrus trees is not only a direct loss of foliage but indicates that in from two to three months later the roots of these citrus trees and the roots of vegetables growing between them will suffer the maximum injury from the grubs hatching from the eggs laid by the female beetles. After this period of greatest injury to the roots, fully grown grubs may be present in the soil and around the roots for several months, but the injury they cause is all past. They are no longer actively feeding. Their growth curve has dropped to zero.

Two kinds of curves may be drawn to represent what has happened. The one representing relative growth is at a high level for the first two months, drops slowly at first but later with increasing rapidity in the third month, and by the fourth month is below zero, continuing here until pupation. The curve showing absolute weights is scarcely apparent in the first month, rises rapidly in the second month, makes enormous gains in the third month, a slight gain in the fourth month (but still at a high level), and drops only a little below this high in the succeeding months to pupation. Except in the latter months, it parallels the curve of injury to the farmer's crops, insignificant in the first two months, attaining a maximum in the third and fourth months, but again dropping to insignificant proportions later, when the grub has ceased to feed and is merely waiting for pupation.

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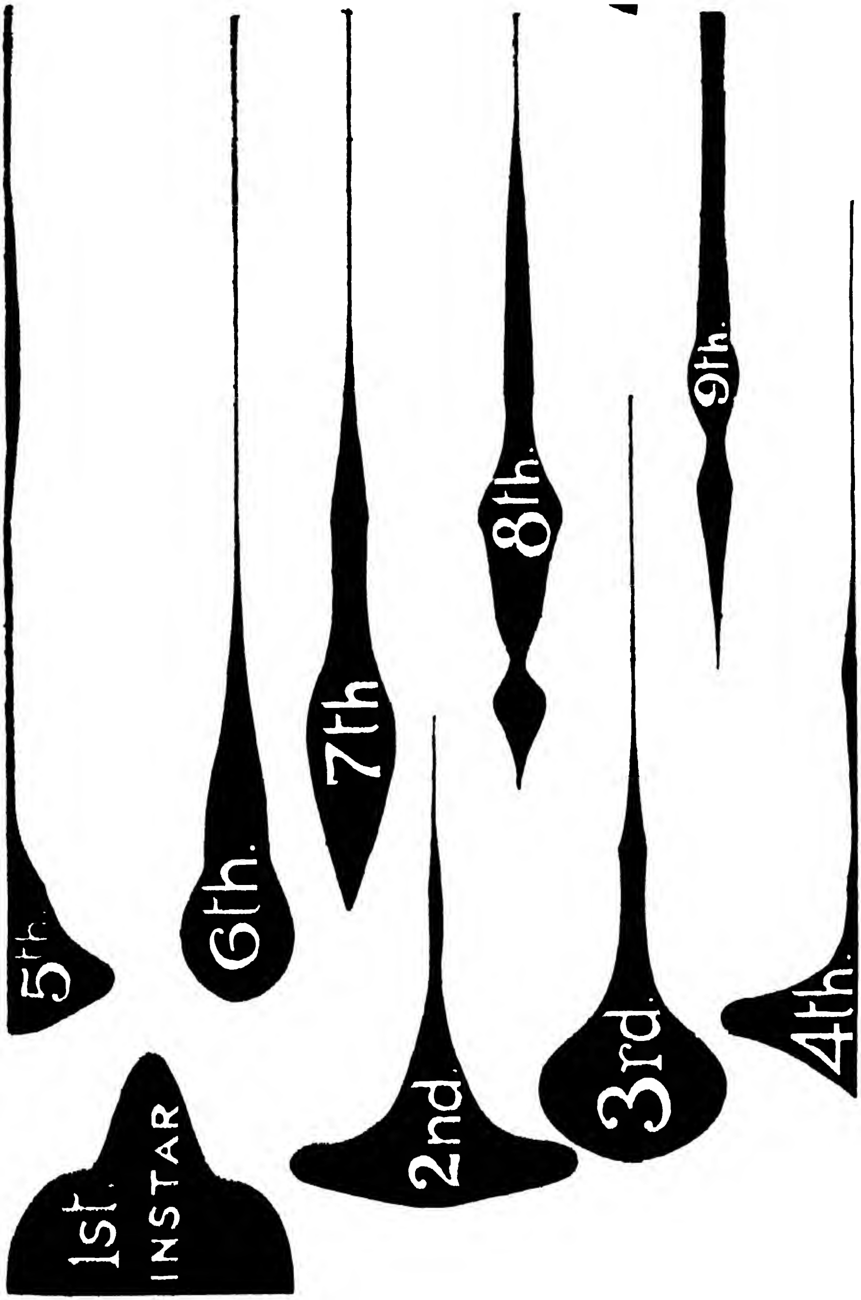
PLATE XIX.

Injury of caterpillars of *Fundella cistipennis* Dyar to pods of sword beans. Note only one uninjured pod of all those shown, the smaller pods being withered and about to drop, the larger ones being malformed by infestation at a later stage of growth. (Original).

PLATE XX.



THE CHANGED STATUS OF SOME INSECT PESTS IN PUERTO RICO

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A few of the insect pests of economic crops in Puerto Rico show little or no change in their status over a period extending as far back as any entomological observations are recorded. For instance, the purple scale of citrus trees, *Lepidosaphes beckii* Newman, has been and still is THE scale for which growers spray or maintain windbreaks, obtaining commercial control thereby, but never reducing its numbers below a certain minimum from which it will promptly recover under favorable conditions. The mole-cricket, or *changa*, *Scapteriscus vicinus* Scudder, is generally quite as much of a pest now as it has ever been in the past, the decrease in its numbers reported by some farmers due to toads being more than balanced by increased damage reported in other districts, due either to a more intensive type of agriculture or to an actual increase in its numbers. In the regions where the use of the standard Paris green-flour mixture for poisoning the *changa* is still in common use, it probably is now less abundant than formerly, but where farmers have reverted to merely protecting young plants against its attack by wrapping them in *mamey* leaves when transplanted, it is subject to no control except natural factors. To be sure, it is eaten by the imported giant toad, *Bufo marinus*, but apparently only in limited areas has a noticeable reduction in its numbers resulted.

Of the pests which have appeared here in recent years, the latest arrival is the cottony cushion scale, *Icerya purchasi* Maskell. A detailed account of this insect is given elsewhere in this number of the Journal (1), noting its peak of abundance in the late spring of 1932, and the role of parasites, predators, entomogenous fungi and hurricanes in its control. *Coccus viridis* Green, the soft green scale of citrus and coffee, was first noted in 1925, and became noticeably destructive in the coffee groves denuded of shade by the hurricane of San Felipe in 1928. Its present status largely depends on local humidity, for its numbers are greatly reduced by at least two kinds of entomogenous fungi attacking it, which thrive during wet weather. Thus it is rarely injurious on large citrus trees, or in coffee groves well protected by shade, but during dry weather may be seriously

injurious on young citrus trees. In 1921, two pests appeared almost simultaneously in Puerto Rico, the pink bollworm of cotton, *Pectinophora gossypiella* Saunders, and the corm borer of plantains and bananas, *Cosmopolites sordidus* Germar, both of which now occur practically everywhere that appropriate host plants are present. The latter pest apparently has no natural enemies, and comparatively few growers practise, or even know, the practical methods of control by which its numbers may be reduced to a minimum. The rapidity with which it has spread, and the abundance in which it is now present, does not indicate, however, that other insects with similar habits will be similarly successful. The sweet potato weevil, *Cylas formicarius* F., altho a most serious pest in the poor, hilly lands of the interior, is of comparatively little importance on the richer loams or the sandy lands of the coast, where the host grows to much better advantage, matures more rapidly, and is further protected from attack by the absence of cracks in the soil thru which the insect can reach the tubers. Even less successful in extending its range is another weevil of sweet potatoes, the scarabee, *Euscepes batatae* Waterhouse, which is still confined to limited areas where the first records of its presence in Puerto Rico were made. Its limited distribution is paralleled in the case of the papaya fruit fly, *Toxotrypana curvicauda* Gerstaecker, which is comparatively rare even in the restricted region where it is present.

For the 29-year period, 1899 to 1928, no generally and seriously destructive hurricanes have happened to strike Puerto Rico. One consequence of this lengthy immunity from hurricanes was that the coffee shade tree ant, the "hormiguilla", *Myrmelachista ambigua ramulorum* Wheeler, became constantly more abundant, for old infested shade trees in the coffee groves became so large that they could not be removed without injury to the coffee trees underneath. The hurricane of San Felipe brought down these old guaba and guamá trees, thus immediately eliminating the great bulk of the hormiguilla population of the grove. Only gradually, over a period of several years, as the freshly planted shade trees again attain considerable size, will the numbers of the hormiguilla again begin to increase.

The hurricane incidentally increased the number of the more common cotton insect pests in the few years immediately following, for the impoverished coffee growers in many cases attempted to grow cotton for a cash crop. Waves of infestation by the leaf caterpillar, *Alabama argillacea* Hübner, swept over these plantings, and infestations of the pink bollworm were built up, culminating in almost

total infestation of the end of the crop for 1931–32. From this high peak, cotton insects rapidly receded, due to the discouraged coffee planters abandoning the crop, and even cotton farmers ceasing to plant on account of low prices and the withdrawal of the sole buyer. The hurricane of San Ciprián in the fall of 1932, destroyed the fruiting portions of the maga trees, thus eliminating the only important alternate host of the pink bollworm along the north coast. Where volunteer cotton plants still exist, the pink bollworm continues to persist, but in the main cotton region, around Isabela, where volunteer cotton plants had been eliminated years ago, the destruction of the fruiting portions of the maga trees and the absence of commercial cotton fields have, temporarily at least, entirely eliminated this pest from the region

Replacing the old standard varieties of sugar-cane grown in Puerto Rico with BH (10)12 and SC 12(4) has considerably increased tonnage and sugar content, but it has also affected the common caterpillar, *Diatraea saccharalis* F., which bores in the stalks, most advantageously to the insect The new canes are larger and softer and sweeter than the old, and they appear to furnish a more desirable environment for the insect Thus the numbers of this, the most serious pest of sugar-cane, have been on the increase, despite the fact that the non-burning of trash has been ever more widely adopted Favoring its parasites by non-burning of trash can not begin to neutralize the effect of a more favorable environment furnished by the new varieties of cane Thus, altho the net result of the change of varieties has been to increase production, this is despite the greater losses at present being caused by *Diatraea*. The stalk borer is not the only insect affected by the change in varieties. What was previously only a minor pest of sugar cane, the yellow aphid, *Sipha flava* Forbes, has also thereby been provided with a greatly superior host, from its standpoint Because of some undetermined peculiarity of Uba and the Java canes, it often becomes enormously abundant on these varieties, and such mass infestations spread to adjoining fields of B H (10) 12 and S C 12 (4), causing much greater and more extensive losses from this pest than were ever known on the standard varieties.

The major and most obvious change which has occurred recently is in the status of white grubs, the numbers of which have decreased so greatly that only rarely and sporadically do they cause serious damage. Fifteen or twenty years ago the damage caused by white grubs had attained its maximum, and at that time they were the

most serious pests of practically every crop grown on the island, such damage being most severe in the irrigated cane lands of the south coast. It was a common occurrence to have nearly mature cane so completely denuded of roots that the stalks could be pulled up with ease, or, in extreme cases, they would fall to the ground at a touch. White grubs were distinctly the main entomological problem in Puerto Rico, and a consideration of methods of control occupied the attention not only of entomologists but of cane growers and field men generally. As none of the methods of chemical control or parasite introduction proposed by the entomologists proved to be economically feasible, or likely to produce results within a reasonable time, the field men were forced to adopt such obvious methods as hand picking of the grubs after the plow and of the adult beetles from young cane, expensive, essentially temporary and only partially effective as such methods admittedly were.

Today it is difficult to realize the seriousness of the white grub menace, for the grubs are no longer present. Hand collection of the grubs and beetles has been almost universally abandoned because it is no longer necessary, and is now so exceptionally used in rare instances only as to indicate how greatly the status of the white grub has changed. To be sure, cultivation practises have been improved, plowing is deeper, the land is better fitted for plant cane, and even the kind of cane itself is changed, being more vigorous varieties with stronger and more rapidly developing root systems, but these are only minor factors to account for the practical disappearance of the native white grubs generally from the cultivated fields of Puerto Rico.

The major factor in a changed environment for white grubs is the introduction and wide-spread dispersal of the giant toad, *Bufo marinus* L. Nearly a third of the food of this animal in cane fields consists of May beetles, the adults of the white grubs. If the toads were comparatively scarce, as are the native toads for instance, their influence might be negligible, but as a matter of fact they are at the present time very numerous, not only along the coast, but also far up into the hillier districts of the interior. On account of their individual size, their abundance, and their preference for May beetles as food, they have rapidly changed the status of white grubs in the cane fields of the south coast, and in the agricultural regions of the island generally, from that of a major pest to one of comparatively minor importance. No prediction can be ventured as to how long this condition will last: whether it is merely a temporary low for white grubs, or whether it may possibly be more or less permanent,

a permanent adjustment to the new factor. When the oscillations of the balance of nature are upset by the introduction of a new major factor, usually the numbers of the host are so greatly reduced by the parasite or predator that the parasite or predator shortly must perish in large numbers on account of lack of food. In the case of such an omnivorous predator as the toad, however, not limited in its choice of food to any particular kind of insect, the prospect of many individuals starving to death on account of lack of food may be indefinitely postponed, even if May beetles become much scarcer than they are at present. A considerable number of other Scarabaeid beetles, of little or no direct economic importance, but almost the equivalent individually of the May beetles in size, are very abundant at times, and these constitute even now a seventh of the food of toads in cane fields, and may come to be a more important factor if the number of May beetles shows a decrease below its present previously unprecedented low.

Combining all the Scarabaeid beetle items in the toad's food (amounting to nearly half of all food eaten) and adding to this an additional quarter consisting of millipedes, one can readily see how little is to be expected from the toad in affecting other insects, for the present at least, and so long as a sufficient supply of May beetles and millipedes is available. Eventually the changa may be much more generally eaten, but it was found to be only one-fortieth of the food in 1930–31 (2). Is it surprising that the changa continues to be a major pest, and that white grubs have almost disappeared?

At times, and locally, even exceeding white grubs in numbers and in the damage it causes to cane is the weevil root-borer grub, *Diaprepes abbreviatus* L., the adult of which is an exclusively aerial, leaf-feeding, short-beaked weevil. The adult beetles rarely feed on cane leaves, but are a serious pest of citrus trees, especially of young trees which have just been set out in the grove, and they also feed on the tender leaves of numerous other trees of little or no economic value. So far as can be judged, the numbers of this pest now average little less than at any time in the past. Altho the exclusively aerial habits of the adults might appear to render them largely immune from being eaten by toads, the weevils in fact form the third largest single item in its food, an eighth of the total. Eventually this may be considerably increased if other large insects, such as the Scarabaeid beetles, become less numerous, and seems not only possible but decidedly probable. One other important factor tending to limit the number of *Diaprepes* is an egg parasite, *Tetrastichus haitiensis* Gahan. Not until 1929 was this common insect discovered in Puerto

Rico, but its so recent discovery can hardly mean that it was not previously present. The parasite is so common that it ordinarily destroys from 50 to 95 per cent of all egg-clusters laid between the leaves of citrus or wild fig, but it can not penetrate to the eggs when they are laid between the split tips of cane leaves, and these only were collected and examined by the earlier investigators. Thus the egg parasite is not a new controlling factor, like the introduced toad. and is static, not likely to greatly increase in importance in the near future.

If any considerable decrease in the number of *Diaprepes* has already occurred (altho at present imperceptible to entomologists or farmers generally), or does occur within the next few years, it presumably will not be due to egg-parasites, but to a scarcity of other food forcing the imported toad to catch and eat larger numbers of these leaf weevils.

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Melville T. Cook and *Pablo Morales Otero.*

Research on Shortening Time Without Affecting the Accuracy of Dyer's Modified Method for Determination in Soils, of Phospheric Acid, Lime and Potash Soluble in Citric Acid Solution.
Juan Amedée Bonnet and *Fernando A. Villamil.*

A Variety of Tobacco Resistant to Ordinary Tobacco Mosaic.
J. A. B. Nolla and *Arturo Roque.*

Pineapple Disease of Sugar Cane in Puerto Rico.
White Spot of Pineapple.
Patho—Anatomy of Roots Attacked by Nemathodes.
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GUM-PRODUCING ORGANISMS IN SUGAR CANE

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The importance of the gummosis disease of sugar cane and the advance in our knowledge of the subject since the publication of the previous papers by the senior author have made a further study of the subject very desirable. The most important of these advancements is in our knowledge of the geographical distribution and of new species or strains.

HISTORY

This disease was reported first from Brazil by Dränert in 1869 but appears to have been known as early as 1863. It was reported next from Australia by Cobb who described the organism in 1894. He believed it to have been in the country as early as 1876. The wide separation of these two countries presented a very interesting problem in geographical distribution. Shepherd, of Mauritius, in his report for the International Survey of the Diseases of Sugar Cane (1932), said that it was probably introduced from Brazil to Mauritius on a shipment of seed cuttings in 1869 and from there to Australia in 1874. North, of Australia, in his report for the same survey, says that it was probably introduced into Australia from Mauritius in 1874. The next report was from Brazil in 1894, but it was less severe than in 1869, probably due to the use of resistant varieties. It was found in Puerto Rico by Matz in 1920 and reported the same year. It was discovered in St. Kitts of the British West Indies in 1925 and reported by Ballou in 1926. It was found and reported from Colombia by Chardón of Puerto Rico in 1926. It was found and reported in Guadeloupe of the French West Indies by Williams

[1] This is the third paper on the gummosis of sugar cane by the senior author. Early in 1932 the junior author began to cooperate in the work and has made the studies on the reaction of sugars to these organisms and also the serological studies.

(16) in 1929. It was reported from Dominica of the British West Indies by Ashby (1) in 1928–29; from St. Lucia of the British West Indies in 1929, and from Antigua of the British West Indies by Illingworth in 1930.

In addition to the above places it has been reported from Fiji Islands, Java, Borneo, Reunion and New Guinea. The report from Java by Groenewege in 1915 was proven to be a mistake by Wilbrink who published the results of her studies in 1920. The disease which was supposed to be gummosis was found to be what is now known as scald (*Phytomomas albilineans* Ashby). The reports from Borneo and New Guinea have not been confirmed.

The symptoms of the disease have been described by many students of the subject. The descriptions by the various authors are very harmonious. The senior author in his description which was published in 1928 makes the following statement:

> "The most reliable external symptom is the leaf streaks referred to by Matz and Cottrell-Dormer. However, this symptom is sometimes present on POJ canes, and occasionally on Uba and some other canes, although it is impossible to find any trace of gumming in the cut surfaces."

Again in a paper read before the plant-pathology section of the Fourth Congress of the International Society of Sugar-Cane Technologists (1932) (8) he said,

> "Although the presence of these stripes is the most important external symptom I am satisfied that it is not always reliable. I have found infected canes which did not show these symptoms and I have found these symptoms in canes which did not show internal gumming or discolorations."

Further studies in Puerto Rico on the symptoms of this disease following the publication of this first paper led to more confusion. The leaf symptoms appeared in several resistant varieties which did not show discolorations or gum in the fibro-vascular bundles of the stems or bacteria in the leaf stripes. Finally the senior author began referring to cases of this kind as "false gummosis". This phase of the problem was solved at the Fourth Congress of the International Society of Sugar-Cane Technologists which met in Puerto Rico, March 1932, when it was found that this "false gummosis" was the same as a disease reported by Dr. Wilbrink of Java in 1929 as "fourth disease" and by Martin of Hawaii in 1930 as "chlorotic streak." It was also learned that this disease had been noted by Bell of Australia who referred to it as "false scald".

The leaf symptoms of this fourth disease or chlorotic streak are very similar to the leaf symptoms of the gummosis. The streaks

may be somewhat broader than in gummosis and the boundaries may be somewhat wavy. As a rule the reddish dots which are characteristic of the gummosis do not develop in fourth disease or chlorotic streak, but there is a reddish margin on the older streaks.

The exudation of gum on the cut surfaces of the canes is the most reliable symptom of the disease. The diseased fibro-vascular bundles are usually discolored, the most common discoloration being red but a discoloration does not necessarily indicate the disease and the absence of gum on the cut surfaces does not necessarily indicate that the cane is free from the disease. During periods of very dry weather diseased canes may show discolorations and but little or no gum. During or following periods of wet weather the canes will show the gum in varying amounts, depending on several factors, such as weather conditions, length of time that the cane has been infected and variety of cane.

Within the past few years certain variations in the morphologic and physiologic characters of the organism have been reported which make further study desirable.

The writer sent cultures to Mr. M. C. Goldworthy of the University of California in 1927 who compared them with cultures sent from Australia by Mr. A. F. Bell for that purpose. Under date of June 27, 1927, he replied as follows:

"Your vascular types are different from those we have received from Australia. That is they behave differently on media. So far I have had no opportunity of comparing the cultures by the serological method."

Ashby (2) (1929) published the results of a study of this disease in the British West Indies in which he reported the finding of two organisms. He said:

"Plantings in peptone saccharose agar made with yellow ooze from the stalks of affected canes in St. Kitts yielded two types of colonies, these, the more rapidly appearing (3 to 4 days) being entire convex, glistening and, at first, colourless but later pale yellow and spreading: the later appearing colonies were entire, flat, deeper yellow, and the growth more restricted. The first type of colony yielded a straw or amber yellow (Ridgway) abundant slimy growth on slanted agar in tubes with a marked tendency to run down and accumulate at the bottom of the slope; after inoculating into milk a shallow clear zone formed at the top of the liquid in two or three days at tropical room temperature with a bulky indistinct clot apparently due to a labenzyme and the reaction became increasingly alkaline. The second more slowly growing type of colony which was yellow from the start yielded a restricted glistening aniline to primuline yellow growth on the agar with a compact slime showing little tendency to flow. In litmus and plain milk no change occurred in a week but there was gradual increase of alkalinity subsequently. As the organism in the first type of colony

showed cultural characters different from those of *B. vascularum* as described by Erwin F. Smith and as those of the second type were in agreement with his description the first type was discarded and attention given to the second.''

He secured cultures from North of Australia and made inoculations in cane in England which enabled him to compare the St. Kitts organism (second type) with Australian organism. The Australian type produced broader stripes, a withering of the heart and a rotting of the apical internodes. It was more severe than the St. Kitts second type. He said:

''The original cultures of the St. Kitts organism (second type of colony) gave rise to a glistening restricted growth on peptone-saccharose agar (saccharose 2.0, with peptone 0.5, dipotassium phosphate 0.05, magnesium sulphate 0.025, agar (bacto) 1.5, water 100.) between aniline and primuline yellow in colour (Ridgway); the slime was compact drawing out, in cultures which had attained their full growth, into elastic threads and showing little tendency to flow. The growth was opalescent in oblique light and gelatine (10 per cent.) of the same composition as the agar medium was slowly liquefied after two weeks. Lavender-colour litmus milk became gradually strongly alkaline and after two to three weeks at 23° C. began to clear from the surface with bleaching. After two to three months the milk had cleared with more or less suspended slime and restoration of the litmus colour but remained permanently strongly alkaline. If the milk carried a layer of fat a yellow growth developed on the surface and there was little deposit; in the semi anaerobic conditions under the layer of fat, bleaching of the litmus was complete for a time, and it appeared that action on the milk was mainly by diffusion of metabolic products through the fat layer. In well-separated milk, surface growth was restricted to a yellow ring, there was active multiplication within the liquid and a good yellow deposit associated with partial bleaching and more rapid restoration of the litmus colour. It is doubtful if, at any time, a true clot was formed, the eventual clearing being apparently due to increasing alkalinity since cleared cultures yielded a bulky precipitate when acidified with hydrochloric acid. The organism which was actively motile in young liquid cultures by means of a single polar flagellum exceeded 0.5 microns in diameter and was from 1.0 to 1.5 microns in length occurring singly, in pairs and more rarely in short chains. Most of the isolations showed colonies similar to those of the original isolation but those from the leaf stripes of Uba were dry, flat, rough and pale yellow with wavy margins, the growth from these colonies on agar slants was at first similar but tended gradually to take on the glistening smooth deeper yellow character of the original form. Some of the cultures from the isolations caused, like the original, a slow liquefaction of gelatine but others showed no trace of liquefaction at room temperatures after three months. The action on milk varied in the rate of change but there was no true clot and all eventually cleared with persistent alkalinity.

''The original culture from Australia gave rise on the agar to convex glistening almost colourless colonies of a fluid slimy consistency which became paler yellow and spreading. On agar slants the growth was abundant, opalescent and fluid slimy, with a tint from straw to amber yellow: the slime tended to flow and accumulate at the base of the slant. On potato the growth was sulphur yellow

fluid and flowing off the surface but not so abundantly as the slime of *B. Malvacearum* E. F. Smith. Gelatine showed liquefaction under a week and a shallow clear zone formed at the surface of plain and litmus milk after three to four days at 23° C associated with the formation of a bulky indistinct clot apparently due to a lab-enzyme; alkalinity gradually increased becoming strong and persistent and the milk was completely cleared after two to three months of 23° C; the clearing appeared to be caused by peptonisation as no precipitation followed acidification with hydrochloric acid. Growth occurred as a yellow slimy layer on the surface of milk with fat present and absent. The organism was actively motile in young cultures and approximated in size to that of the St. Kitts form.

"The colonies which appeared in platings made from the inoculated canes were not uniform in type; some resembled those of the original culture, but they were as a rule, mingled with others showing a piled-up deeper yellow colour, a dark opaque nucleus, and little tendency to spread; others again were at first flat, but changed to the second type after a few days. Transfers from the different colonies to agar slants yielded, however, a similar pale yellow slimy fluid growth like that of the original form. All cultures from isolations behaved like the original culture in liquefying gelatine appreciably within a week and clotting milk in three to four days at 23° C. with gradually increasing alkalinity and in clearing it eventually but with marked differences in the rate of clearing as cultures from the second or 'piled' up type of colony were slower in action. The isolation from Australia, showed therefore, cultural characters similar to those of the first type from 'gummed' cane in St. Kitts, and it is believed now that they are probably identical. As the cultures made from the isolations out of the different varieties were essentially similar to the two types used for inoculation, and as no evidence was obtained that the one type could change into the other, it would appear that two yellow forms may cause Gummy Disease occurring in some instances together and which differ in cultural characters enough to be considered as distinct varieties of *B. vascularum*. The strain described by Erwin F. Smith resembles the second type from St. Kitts differing from some cultures of it only in not eventually clearing milk, a difference which appears to depend on the amount of alkali produced; the alkaline body is either ammonia or an amine as the vapour from boiling cultures turns red litmus paper blue."

In August, 1930, a gummosis disease was discovered on POJ 2878 at Jayuya, a point located in the center of the island and at an elevation of about 2,000 feet. This was especially interesting because this variety was supposed to be immune or highly resistant.

The cane was sent to the laboratory and put in a moist chamber, where it produced a typical gumming within 24 hours. Owing to the fact that this variety was supposed to be immune, the senior author and Mr. Pedro Richardson, Agronomist, visited Jayuya in order to make sure that it was POJ 2878. After a careful examination, it was decided that there was no doubt as to the variety. The symptoms were not quite typical. However, the gumming was so pronounced that it was detected by the foreman who was making cuttings for planting. The behavior of the organism in culture was typical of *B. vascularum*.

This outbreak was described by the senior authority------------ as follows:

"The cane was about seven months of age from date of planting and the infection was well over 75 per cent.

"The external symptoms were somewhat different from those described by the various writers on the subject. The early symptoms were not found but the late symptoms were very abundant. These symptoms consisted in a dying of the tissues in the leaves along the veins, thus producing elongated areas of dead tissue which frequently extended to the leaf margins. In many cases the margins of the leaves also were dead. When the tops of the canes were cut across, many of them showed a gumming, which was much more pronounced when the cuttings were kept in moist chamber for a few hours.

"The gum was not the typical honey yellow which has been described by several writers, but ranged from clear to creamy white or yellow, and in some cases was slightly tinted with honey yellow."

The further history of this outbreak is as follows:

A field test with healthy P.O.J. 2878, 2883, 2714, 2727, P.R. 801, 803, 807, 809, 820, 826, F.C. 916 and Guadeloupe 119 was started in which every third row was planted with infected P.O.J. 2878, so that every variety of healthy cane was in contact with an infected row. The rows were five feet apart and consisted of 50 stools each. The field of infected cane was plowed out.

At this same time cuttings of the same varieties were set in our greenhouse, and the young canes inoculated with cultures prepared in the laboratory. Some of P.O.J. 2878, 2883, P.R. 807, 809, 826, F.C. 916 and Guadeloupe 119 developed slight symptoms and the organism was recovered from them but in an attenuated form. After a time the new growths failed to produce symptoms and it was impossible to recover the organism.

The field test was cut January 20th, 1932, and carefully examined by the writer. Neither symptoms nor gumming were found in any of the varieties, nor in the rows planted with infected cane. A few canes showed slight discolorations of the fibro-vascular bundles, but no gumming. They were brought to the laboratories and used for cultures. P.O.J. 2883 and F.C. 916 produced a gum organism which is not typical. The color of the gum is greyish, almost clear; some times tinted with yellow.

The greenhouse tests made by the writer with organism from P.O.J–2878 at Jayuya lead the writer to believe that P.O.J.–2878, P.O.J.–2883, P.R.–807, P.R.–809, P.R.–826, F.C.–916 and Guadeloupe 119 may be symptomless carriers although this has not been demonstrated. However, the studies during 1933 show that P.O.J.–2878 when inoculated with an extremely virulent strain of *B. vas-*

cularum will sometime develop leaf symptoms. It is the opinion of the writer that these varieties are so resistant as to be practically immune and that the experiments indicate that it is possible for a very highly resistant or apparently immune variety to be a carrier of this disease.

Cultures for P.O.J. 2878 were sent from Puerto Rico by the writer to Mr. A. F. Bell of Australia for comparison with the Australian organism. He replied as follows:

"I desire to acknowledge receipt of your letter of 22nd October, also of four cultures. Of the latter three were apparently pure and one contained a yeast. The former were re-isolated and examined and compared with the organism of leaf-scaled, gumming, red stripe, and mottle stripe. Your organism is quite distinct from any of these four.

"Parallel inoculations were made (in the transfer chamber) into cut shoots of Badila and from this small test your organism seemed much more virulent than the above four stains.

"At the end of two days the lesions were about one-fourth inch in diameter and consisted in dark-red rings surrounding a water-soaked greenish or yellowish area. Later the centers became ashy coloured and the red ring surrounded by a yellowish halo.

"I enclose a photograph of the lesions. The cultures and experimental material have now been destroyed. Our experience so far it that P.O.J. 2878 is highly resistant to gumming disease."

The senior author wrote another letter to Mr. Bell making inquiry as to the morphological characters of the Puerto Rican and Australian organisms. He replied (under date of March 30th, 1931) as follows:

"Your letter of 10th February to hand. With reference to the organism you sent, this was quite distinct from our *B. vascularum* both culturally and morphologically. One considerable difference was that the organism received from you had flagella at both poles while the gumming organism has a singled flagellum only. The organism to which it bore most resemblance was that causing mottle stripe."

An examination of the photograph (Fig. 2) of this organism, made by Mr. Bell, shows that it is quite distinct from *B. vascularum*. The studies by Ashby and by the senior author emphasize the importance of more extensive studies on this disease and its cause or causes in different parts of the world.

1932 Studies

There was a severe outbreak of gummosis on the small island of Vieques in March and April 1932 and slight outbreaks in the vicin-

ity of Río Piedras and Canóvanas. The senior author made a special study of infected Cristalina from the island of Vieques on a very small mixed planting near Canóvanas and on mixed plantings containing Cristalina near Río Piedras during 1932. Vieques is a small island just east of Puerto Rico and has much less rainfall than Puerto Rico. Cristalina has been retained there as the variety of major commercial importance long after it gave way to other varieties in Puerto Rico. It is very susceptible to this disease and the infection is very near to 100 per cent. The rainfall was exceptionally high during the spring of 1932 and the disease was very evident Most of the cuttings showed a high yield of gum.

Many cultures were made and studied. The results confirmed the opinions of the senior author which were published in 1928. There were many strains which varied in color and character of growth. These results are shown in table I.

TABLE I.

No.	Source	Color	Growth on new cul.	Inoc 6/20 Symptoms 6/24	June 18th Symptoms	July 1 Symptoms	July 18 Symptoms
1	Australia.....	Yellow ...	Poor	POJ-2878 none	Crist none..	POJ 2878 none ..	None
2	Jayuya FC-916	White ...	Poor. . .	POJ-2878 none	Crist none.	POJ-2878 none .	None
3	Vieques 6082.......	Canary Yellow	Poor.....	POJ-2878 none	Crist none..	POJ 2878 none .	None
4	Vieques Crist......	Yellow ...	Good	POJ-2878 none	Crist none..	POJ-2878 none	None
5	Vieques..........	Yellow ...	Fair	Very Slight	Crist none..	POJ-2878 none . ..	None
6	Vieques	Yellow .	Good	Good	Good	POJ-2878 none	Slight
7	Vieques......	Yellow ...	Good	Very Slight.	Very Slight.	Slight	None
8	R. P. Crist..........	Yellow ...	Good.....	Good	Good.......	18 in. ...	Slight
9	Jayuya POJ-2878..	White ...	Poor	Very Slight	Slight	1½ in.....	Slight
10	Vieques....	White . .	Good	Slight	Very Slight.	Outgrown	None
11	Vieques............	Yellow ...	Fair	Slight	None	Outgrown	None
12	R. P. H.—109 slow..	Yellow ...	Fair	Slight	Very Slight.	Outgrown	None
13	R. P. H.—109 slow..	White	Poor	None.......	Very Slight	Outgrown	None
14	R. P. H.—109 slow..	White ...	Poor......	Slight	None	None....	None
15	R. P. H.—109 slow..	White ...	Good	Slight	Very Slight.	Outgrown	None

R. P. H.—109 = H 109 from Río Piedras.

The results given in this table confirm the opinion of the senior author expressed in 1928 that this species included a large number of strains which varied in color, growth and virulence.

1933 Studies

The first half of 1933 on Vieques was very dry as compared with 1932. The Cristalina and Rayada (a variety of Cristalina) canes were very heavily infected with *B. vascularum* but the exudation of gum was much less than in 1932. A large number of isolations were made and used for laboratory study. All the cultures used in 1933 were new and from Vieques canes except three: Nos. 1 and 2 were 1932 cultures which had lost their virulence but made excellent growths on agar. No. 23 was a culture sent to the senior author by Mr. A. F. Bell of Brisbane, Australia, late in 1932 and received in January, 1933.

The laboratory studies showed a large number of strains which possessed the following characters:

1. *Color.*—Various shades of yellow and milk white, while others were clear or sometimes clear and slightly tinted with yellow. A few were brownish. In many cases the first growth of a yellowish exudation was white when transferred to agar. Many strains changed color on the agar. The strains were grown on different media and at different pH but up to the present time the changing of colors has not been explained. The best growths were made in acid media but good growths were made on alkaline media as high as pH 9.6 although it was slower than on the acid media. Strains also changed from rough to smooth and smooth to rough without any apparent cause.

The variations in color were in harmony with those reported by the senior author in 1928. Cobb reported variations in color in 1905 but other writers did not give much attention to this phase of the subject. Possibly the material which they were studying did not show the extensive variations which are reported by the authors of this paper.

Some strains were extremely virulent while others were slightly virulent as shown by the leaf symptoms. Others did not produce leaf symptoms but grew in the canes as was shown by the exudations when the canes were cut and kept in a warm, moist chamber.

There was very little relationship between color and virulence although in general it may be said that the yellow strains were slightly more virulent than the others.

No experiments were made to determine temperature relationships but cultures that were put in incubators and refrigerators died in a short time.

Two series of inoculations were made and recorded in Table II. Other inoculations were made but the results were the same as shown in this table.

TABLE II.

No.	Color	
1	Yellow	No infection. Was virulent in 1932.
2	White	No infection. Was virulent in 1932.
3	White	No infection.
4	Almost clear	No infection.
5	White, yellow with age	Mild symptoms on Cristalina.
6	Yellow	Symptoms on Cristalina and H-109.
6	White	Symptoms on Cristalina and H-109.
7	Yellow	Symptoms on Cristalina and H-109 and POJ-2878.
8	White, yellow with age	Not infectious.
9	Clear, brown with age.	Not infectious.
10	White, brown with age	Not infectious.
11	White	Mild symptoms on Cristalina.
12	Whitish, almost clear.	Not infectious.
13	Yellow	Symptoms on Cristalina.
13	White	Symptoms on Cristalina.
14	White	Not infectious.
14	Yellow	Not infectious.
15	White	Very slight symptoms on Cristalina. Developing very slowly.
16	Clear, yellow tint	Mild symptoms on Cristalina and H-109.
17	Clear, yellow tint	Mild symptoms on Cristalina and H-109. Developing very slowly.
17	Yellow	Not infectious.
18	White	Not infectious.
19	White	Symptoms on Cristalina and H-109.
22	White	Symptoms on Cristalina and H-109 and POJ-2878.
23	Yellow	Very mild symptoms on Cristalina
24	Clear, white tint	Symptoms on Cristalina, H-109 and POJ-2878.
25	White	Symptoms on Cristalina and PR-803.
26	Yellow	Symptoms on Cristalina.
27	Yellow	Symptoms on Cristalina, H-109 and POJ-2878. Very slight symptoms on FC-916.
28	Light yellow	Symptoms on Cristalina, H-109 and very slight symptoms on M-28.
29	White	Symptoms on Cristalina.
30	Yellow (rough)	Symptoms on Cristalina and POJ-2878.
31	Yellow (smooth)	Symptoms on Cristalina. Slight symtoms on PR-803.
32	White	Symptoms on H-109
32	Clear	Symptoms on Cristalina.
33	White	Symptoms on Cristalina.
34	Yellow	Symptoms on Cristalina.
35	Yellow	Slight symptoms on Cristalina.
36	Yellow	Symptoms on Cristalina.

Nos 1 to 23 inoculated 5/5/33. Nos 24, 36, inoculated 5/19/33. Time for appearance of leaf symptoms one to three weeks, occasionally longer. Nos. 1 and 2 were 1932 culture which lost their virulence. No. 23 from Australia. All others were 1933 cultures.

METHODS OF INOCULATIONS

Several methods of inoculation were used as follows;

1. Pricking the cultures into young cane or leaves with a needle. This was successful but slow and the percentage of takes less than with the other methods.

2. Cutting of the tops of the canes almost down to the growing points and the immediate application of the organism in agar. Then covering the mass with a pad of wet cotton. These inoculations were made late in the afternoon so that the agar would remain moist as long as possible. In some cases distilled water was poured on the cotton one or more times during the following day. The inner leaves push upward within 48 hours and if the variety is very susceptible white streaks will be found running downward. Varieties that are practically immune will not show these streaks. Sometimes streaks

three or four inches in length, will develop in highly resistant variety. However, they do not lengthen after the first few days and the organism dies.

3. Cutting a small hole into the spindle above the growing point and the insertion of the organism from an agar culture. Within ten days or two weeks the injured parts of the leaves pushed out and unrolled. The presence of the organism could be determined by the development of white streaks in the leaves running up and down from the point of injury. The variations in time depended on the resistance of the variety and the virulence of the strain in the culture.

4. The inoculation of the organism from agar cultures into the stem below the growing point. This method was successful but slow. A high percentage of gum pockets resulted.

5. Removing the upper half of an advanced cane so as to force the development of side shoots. When the side shoots are well advanced cut holes in the old cane and insert agar containing the organism.

6. The insertion of pieces of diseased cane into slits in the spindle or cane. The results were practically the same as when agar cultures were used but more uncertain.

7. Inoculation of seed cuttings by the insertion of the organism from cultures in holes cut in the seed pieces. This method was slow and the results irregular.

The results of the inoculations not given in the Table II may be summarized as follows:

Rapid-growing canes respond to inoculations much more readily than slow-growing canes.

Canes inoculated with a culture may show negative results at one time and mild symptoms at another time. The symptoms may develop more slowly in some cases than in others although the inoculations are made from a single culture and on one variety. Some strains do not produce leaf symptoms but do produce gum in the canes and in cultures.

When an infected cane is cut across and placed in a warm, moist chamber, the gum oozes out on the cut surfaces, sometimes in such great abundance as to cover the entire cut area. Two or more colors may emerge from a single piece. When the gum is transferred to agar plates, it makes a very rapid growth. Sometimes all the colors persist and sometimes the deep yellow makes a clear growth. Some of the clear growths from yellow gum become yellow later and some remain yellow. The yellow strains show a great tendency to produce modifications of yellow and sometimes become clear or white. Some

strains grow much more luxuriantly than others. Some strains are much more virulent than others. Some strains that produce gum in the cane and in culture do not produce leaf symptoms. Positive results may be obtained from cultures of all colors and all tints but in general the yellows are more virulent than the other colors.

Bacteriological Study

Twenty-seven cultures collected in 1932 and previous to that date were studied and classified as follows:

Group I.—Is composed of five cultures isolated from the island of Vieques. They produced an abundant canary-yellow growth in twenty-four hours. They are bacilli arranged parallel and side to side, motile and show no spores nor capsules. The colonies are homogeneous, entire edged, straw in color, stain negative to Gram, growth in broth is turbid, agar stroke is slow, confluent, smooth, viscid and opaque and show no change in litmus milk. It does not ferment dextrose, lactose, dulcite, manite, maltose, sucrose, xylose or arabinose; does not produce hydrogen sulphide nor indol; the V.P. and M.R. reactions are negative; does not reduce nitrates, has no odor and emulsify very poorly. This group of organisms is identical with the cultures of *B. vascularum* isolated in Australia that we had previously studied.

Group II.—This group consisted of twelve cultures isolated from "Cristalina" cane in Vieques and from "F.C.–916" cane in Jayuya Some produced a whitish-gray growth while others had a lemon-yellow growth. They are bacilli arranged side by side, parallel or end to end, motile, have no spores nor capsules. The colonies are homogeneous, entire edged, and straw in color. They are negative to Gram stain, grow slowly in broth with slight turbidity. In agar the growth is slow, confluent, raised, smooth, viscid and opaque There is no change in litmus milk, no acid is produced in arabinose, xylose, dextrose, lactose, dulcite, manite, maltose and sucrose. They produce no hydrogen sulphide and no indol; the V.P. and M.R reactions are negative; they do not reduce nitrates, do not produce any odor and have a poor emulsificability.

Group III.—Is composed of ten cultures isolated from "P.O.J.-2878" at Jayuya and "Cristalina" cane from Vieques. The growth of some of the cultures is absolutely colorless and in others is enamel white. They are bacilli which are found singly or in short chains, motile, form no spores nor capsules and are negative to Gram stain. The colonies are granular, straw in color and have entire edge. The

growth in broth is slight turbid with filament and at times a ring adherent to the tube is formed. The agar stroke is filiform, elevated, smooth and translucent or white. They do not ferment dextrose, maltose, manite, xylose, sucrose, arabinose or dulcitol; they do not produce hydrogen sulphide and the V.P. and M.R. reactions are negative. They do not reduce nitrates, have no odor and have poor emulsificability.

The cultures studied differ in pigment production but their sugar fermentations are similar. In 1933, eighteen cultures have been studied, ranging in color from yellow, white, creamy, lemon-yellow, grayish white to colorless. Thirteen of the cultures are bacteriologically similar to the description given in Group I of the 1932 cultures, that is, they are Gram negative organisms, motile, do not ferment any of the sugars tested, do not produce hydrogen sulphide, have no change in litmus milk, do not produce indol, do not reduce nitrates, the V.P. and M.R. reactions are negative, they have no odor and have very poor emulsificability.

TABLE III.

FERMENTATION REACTION, 1933 CULTURES

Culture B	Isolated from	Color	Glucose	Manite	Lactose	Xylose	Saccharose	Maltose	Dulcite	Arabinoses
23	Australian culture...	Yellow	.....	.....	.....	.....	...	....	.....	......
24	Cristalina...........	White	...	.....	.....	......	.....	.....	....	......
25	Cristalina...	White	.....	.....	.....	......	.....	.....	.	......
26	Cristalina............	White	+	+	....	+	+	+	+	+
27	Cristalina....	Yellow	...	....	....		.....	...	. ...	......
28	Cristalina......	Creamy yellow...	.. ...	. ..	.....	.....	.....	.....	....	......
29	Cristalina...........	White	....	....	.....	......	....	....	....	......
30	Cristalina............	Creamy yellow..	....	.....	.. .	......	......	.....	.....	......
31	Cristalina............	Creamy yellow..	.....	....	....	......	.. ...	......	.....	......
32	Cristalina............	Colorless	......	......	.. .	....	.....	.....	.....	......
32 c	Cristalina	Yellow	....	. ...	....	.....	. ..	.....	.. .	......
33	Cristalina............	White	+	+	......	+	+	+	+	+
34	Cristalina...........	Yellow	.....	.....	.....	.....	....	.....	.. ..	......
35	Cristalina............	Grayish white....	.....	......	.....	....	......	....	.....	.....
36	Cristalina............	Grayish white...	.....	.....	.....	......	......	.....	.. ..	......
37	Cristalina............	White	+	+	.....	+	+	+	+	+
38	Cristalina............	Yellow	+	+	. ...	+	+	+	+	+
39	Cristalina............	White	+	+	......	+	+	+	+	+

There are five cultures labeled 26, 33, 37, 38 and 39 which range from white to yellow color and which are absolutely different from the others macroscopically. They are bacilli arranged singly, motile, form no spores nor capsules. The colonies are finely granular, straw in color and entire edged. They are Gram negative. The growth in broth is heavy and granular; agar stroke is filiform, elevated, smooth and whitish in color. They produce slight acidity and coagulation in milk. They produce acid and gas in glucose, manite, xylose,

sucrose, maltose, dulcite and arabinose. They do not ferment lactose. They produce hydrogen sulphide; indol is negative; V.P. and M.R. reactions are negative; they have no odor and emulsify very poorly. These cultures produce a gummy substance but it is still questionable to our mind if they produce true gummosis.

Serological

Two rabbits were inoculated intravenously with cultures 32 c and 33, respectively, and two potent antisera were obtained. By direct agglutination cultures 23, 24, 25, 27, 28, 29, 30, 31, 32 and 32 c, 34, 35 and 36 agglutinated to different titers with antiserum 32 c, while they did not agglutinate at all with antiserum 33. The same was true of cultures, 33, 26, 37, and 39, which agglutinated with antiserum 33, but did not agglutinate at all with antiserum 32 c. This demonstrates that 13 cultures are antigenically alike, one of these strains, 23, being a known gummosis strain isolated from Australia. The other five cultures, i.e., 33, 26, 37, 38 and 39, are antigenically different from the first 13 cultures studied.

Acknowledgments

The authors wish to express thanks to Mr. Arturo Riollano for making frequent shipments of diseased cane to the senior author, and to the following workers in the United States Department of Agriculture for hearty cooperation; to Dr. E. W. Brandes, to Mrs. Starrett and Miss Katherine Bryan for making micro-preparations and for photographing, and to Mr. Brewer and Dr. Astchwager for making photographs of the organism. Also to Mr. Arthur F. Bell, of the Bureau of Sugar Experiment Stations of Brisbane, Australia, for sending cultures and photographs for study.

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Explanation of Plates

The photographs were not made on the same scale but the measurements were practically the same in all cases.

Fig. 1.—*B. vascularum.* Photographed by W. Cottrell-Dormer of the Bureau of Sugar Experiment Stations, Brisbane, Australia.

Fig. 2.—The organism from the gumming cane (P.O.J.–2878) at

Jayuya, Puerto Rico. Photographed by A. F. Bell, of the Bureau of Sugar Experiment Stations, Brisbane, Australia, from a culture sent to him by the senior author.

FIG. 3.—*B. vascularum* from white culture from Cristalina from Vieques.

FIG. 4.—*B. vascularum* from yellow culture from Cristalina from Vieques.

NOTE.—Numbers 3 and 4 photographed by Mr. Brewer and Dr. Artschwage of the U. S. Department of Agriculture.

PLATE XXI

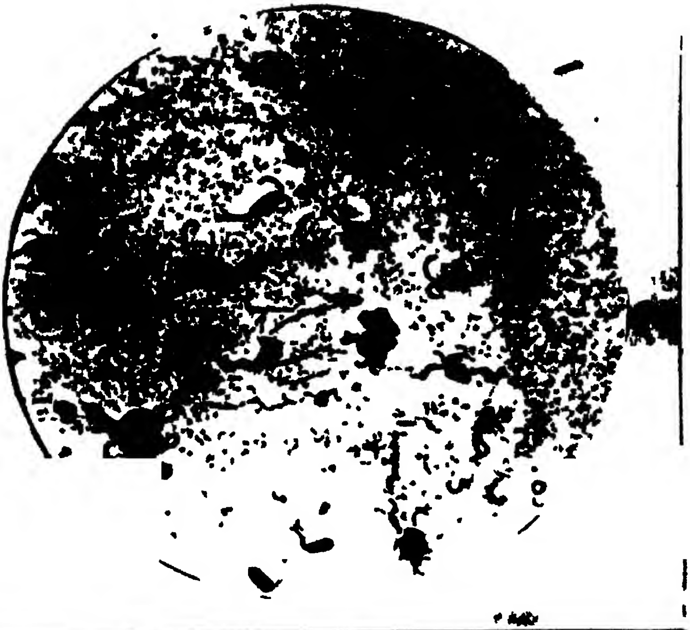

PLATE XXII

RESEARCH ON SHORTENING TIME WITHOUT AFFECTING THE ACCURACY OF DYER'S MODIFIED METHOD FOR THE DETERMINATION IN SOILS, OF PHOSPHORIC ACID, LIME AND POTASH SOLUBLE IN CITRIC ACID SOLUTION (1 PER CENT)

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Since the soil survey of Puerto Rico started in 1928 under the joint cooperation of the U. S. Bureau of Chemistry and Soils and the P. R. Insular Experiment Station, the soil samples sent by the field staff have been analyzed for phosphoric acid, lime and potash soluble in 1 per cent citric acid solution. Before this research was undertaken as one of the projects of the new Soils Division officially created in June 1931, the method used was as follows:

DYER'S MODIFIED METHOD (3)

"Place 100 grams of the air dried soil sample in a Winchester acid bottle. Add 1 liter of a 1 per cent citric acid solution. Shake in a shaking machine 6 hours. Let stand overnight to clear. Filter off about 700 cc of the clear supernatant liquid through a double filter paper. Evaporate exactly 500 cc nearly to dryness in a 600 cc beaker on the hot plate, then transfer the resulting dark colored solution to a platinum dish (using hot water) and evaporate to dryness on a water bath. Completely dry the sticky residue (2 hours in a hot air oven at a temperature of about 120° C.).

"Ignite the residue in the platinum dish in a muffle at low temperature (dull redness) for about 2 hours to remove organic matter. The char should now be gray in color. Moist with con. HCl, add a little hot water and evaporate to dryness on the water bath. Leave on water bath at least 1 hour to dehydrate any silicic acid still remaining as such. Take up in a little con. HCl; add a little water; heat one-half hour on a water bath; add more hot water and filter. Wash five times with hot water slightly acidified with HCl; make up to at least 300 cc with hot water. To the clear filtrate add 2 or 3 cc of con. HNO_3 and boil 15 to 20 minutes to oxidize all organic matter in solution. Precipitate Fe, Al, Ti and P_2O_5 with NH_4OH in

hot solution, filter and wash free from chlorides with hot water. In case of insufficient Fe to color the solution slightly brown, add a few cc of a 10 per cent $FeCl_3$ solution before precipitation. (This is to insure complete ppt. of P_2O_5.)

Phosphoric Acid, P_2O_5

"Dissolve the above ppt. in dil. HNO_3 and boil. Cool slightly, *nearly* neutralize with NH_4OH add 5 grm. NH_4NO_3 and ppt. P_2O_5 with 25 cc molybdate sol. at 65° C. Let stand 20 min. at 65° then let cool. Filter through asbestos, thoroughly wash and det. P_2O_5 volumetrically.

Lime, CaO

"Evaporate down to 150 cc the filtrate from Fe and Al, make very slightly alkaline with NH_4OH and ppt. Ca as oxalate with ammonium oxalate in hot solution. Let stand on the water bath 1 hour then cool over night. Filter, wash with cold water, dissolve in H_2SO_4 (1 to 5 by vol.) and titrate with standard $KMnO_4$.

Potash, K_2O

"Acidify filtrate from Ca slightly with dil. H_2SO_4. Evaporate to dryness in a beaker, transfer to platinum dish and run to dryness. Carefully ignite off excess of H_2SO_4 and all ammonium salts over a free flame; take up residue with hot water, filter into porcelain evap. dish and add 2 or 3 drops of dil. HCl and sufficient platinic chloride sol. to ppt. all the potassium. Evaporate nearly to dryness, filter, wash and weigh as potassium platinic chloride in the usual gravimetric way."

Experimental

The modified procedures introduced have been as follows:

Place 150 grams of the air dried soil sample in a Winchester acid bottle. Add 1500 cc of a 1 per cent citric acid solution. Shake in a shaking machine, 6 hours. Let stand overnight to clear. Filter.

Phosphoric Acid, P_2O_5

Measure in a beaker, 500 cc of the filtered citric acid extract. Add 10 cc HNO_3 and 30 cc HCl. Evaporate in hot plate, nearly to dryness. Transfer to evaporating dish and dry residue carefully, in sand bath. Ignite the residue at low temperature to destroy the un-

decomposed organic matter and complete the dehydration and destruction of silicates. Dissolve in 5 cc HNO_3 and 15 cc HCl, dilute with water and filter. Follow official molbydate volumetric method. (If a brown color due to manganese persists in the solution after neutralizing with NH_4OH and acidifying with HNO_3, heat to coagulate the colloidal suspension and filter.)

Lime, CaO

Measure in a beaker, 100 cc of the filtered citric acid extract. Determine lime by Chapman's (4) method as follows:

To the solution containing Ca, Mg, Mn, Fe, Al, Ti, and P_2O_5 add about 6 grams of NH_4Cl. One gram of oxalic acid in solution, 10 cc of 1.76 normal acetic acid, and 10 drops of .04 per cent brom cresol green, are added. The solution is made to a volume of about 200 cc and brought nearly to boiling. Dilute ammonia is added slowly until a drop of the solution added to a drop of brom cresol green in a porcelain spot plate changes from yellow thru yellowish green to the first pure green (pH3.9–4.2). The solution is then boiled gently for five minutes, the calcium precipitating in a coarse crystalline state. The precipitate is then allowed to st·nd on a steam bath until it wholly subsides. Allow the solution to cool before filtration. Wash five times with cold water. Determine CaO by the official permanganate volumetric method.

Potash, K_2O

Evaporate 500 cc of the filtered extract nearly to dryness, on the hot plate. Transfer the resulting dark colored solution to a silica dish (using hot water) and carefully evaporate to dryness on a sand bath. Ignite the residue in a muffle to about 1000° F. (incipient red heat) for about 2 hours to remove organic matter. Add 15 cc HCl, add a little hot water and evaporate to dryness on the water bath. Take up in 5 cc of HCl and water, heat for 30 minutes on a water bath; add more hot water and filter. Wash three times with hot water and make up to about 200 cc. To the clear filtrate add 2 cc of HNO_3 and boil 10 minutes to oxidize all organic matter in solution. In hot solution, precipitate Fe, Al, Ti and P_2O_5 with NH_4OH adding also 25 cc of saturated ammonium oxalate solution to precipitate Ca and Mg. Filter and wash well with hot water. (In case of insufficient Fe to color the solution slightly brown, add a few cc of a 10 per cent $FeCl_3$ solution before precipitation. This is to insure complete precipitation of P_2O_5.)

To filtrate add 2 cc H_2SO_4 (1:1) and evaporate to dryness in sand bath. (It is convenient to add 5 cc of HNO_3 before evaporating to dryness to avoid losses due to the creeping out of the salts.) Ignite to whiteness to expel ammonium salts. Extract with hot water and filter. Determine K_2O by the official Lindo-Cladding method.

Analytical Results of Percent CaO by Chapman's Method

Comparative values by Student's method of percent CaO as determined by Dyer's modified and Chapman's methods are expressed in table I. To eliminate personal error, all analyses by both methods were performed in the same extraction by the same chemist, F. A. Villamil. The letters A or B following a sample number represent duplicate extractions. The values in columns A and B represent per cent CaO obtained respectively, by the Dyer modified method and by the Chapman method. The values of column (A–B) are obtained by subtracting the values of column B from those of A. The factor .9702 was obtained by dividing the total of column A by that of B. The values of column C are obtained by multiplying that factor by the values of column B. The values of column (A–C) are obtained by subtracting the values of column C from those of A. The values D and D^1 represent mean deviations. The standard deviation of the mean of column (A–B) is obtained by the formula:

$$S.\ D. = \sqrt{\frac{SmD^2}{n(n-1)}}$$

where SmD^2 is the sum of the values D^2 and n, the number of observations. The standard deviation of the mean of column (A–C) is obtained by that same formula substituting $Sm(D^1)^2$ for SmD^2.

The value Z represents the ratio of the mean of column (A–B) to the square root of the mean of the values D^2. The value (Z^1) represents the ratio of the mean of column (A–C) to the square root of the mean of the values $(D^1)^2$. The statistical interpretation of the results was obtained with values Z and n in the Student's table modified by Love (9), n = 91 in this case.

TABLE I

COMPARATIVE VALUES BY STUDENT'S METHOD OF PERCENT CaO AS DETERMINED BY DYER'S MODIFIED AND CHAPMAN'S METHODS

No	Dyer's A % CaO	Chapman's B % CaO	A − B	D (A − B + 014)	D^2	C (9702B)	A − C	D (A − C − 0004)	(D)^2
1	266	288	022	− 008	000064	279	− 018	− 0184	00017956
2	697	731	− 034	− 020	000400	709	− 012	− 0124	00015376
3	241	260	− 019	− 005	000025	252	− 011	− 0114	00012996
4	118	126	− 008	006	000036	122	− 004	− 0044	00001936
5	084	118	− 034	− 020	000400	114	− 030	− 0304	00092416
6	051	064	− 013	001	000001	062	− 011	− 0114	00012996
7	518	529	− 011	003	000009	513	005	0046	00002116
8	065	070	− 005	009	000081	068	− 003	− 0034	00001156
9	081	095	− 014	0	0	092	011	− 0114	00012996
10	868	958	− 090	− 076	005776	929	− 061	− 0614	00376996
11	110	137	− 027	− 013	000169	133	− 023	− 0234	00054756
12	087	098	− 011	003	000009	095	− 008	− 0084	00007056
13	378	403	− 025	− 011	000121	391	− 013	− 0134	00017956
14	079	084	− 005	009	000081	081	− 002	− 0024	00000576
15	171	168	003	017	000289	163	008	0076	00005776
16	266	314	− 048	− 034	001156	305	− 039	− 0394	00155236
17	952	960	− 008	006	000036	931	021	0206	00042436
18	554	596	− 042	− 028	000784	578	− 024	− 0244	00059536
19	137	151	− 014	0	0	147	− 010	− 0104	00010816
20	129	154	− 025	− 011	000121	149	− 020	− 0204	00041616
21	224	238	− 014	0	0	231	− 007	0074	00005476
22	756	795	− 039	− 025	000625	771	− 015	− 0154	00023716
23	286	305	− 019	− 005	000025	296	− 010	− 0104	00010816
24	244	252	− 008	006	000036	244	0	− 0004	00000016
25	594	605	− 011	003	000009	587	007	0066	00004356
26	532	546	− 014	0	0	530	002	0016	00000256
27	644	650	− 006	008	000064	631	013	0126	00015876
28	487	504	− 017	003	000009	489	− 002	− 0024	00000576
29	616	622	006	008	000064	603	013	0126	00015876
30	305	314	− 009	005	000025	305	0	− 0004	00000016
31A	064	067	− 003	011	000121	065	− 001	− 0014	00000196
31B	064	067	− 003	011	000121	065	− 001	− 0014	00000196
32	599	602	− 003	011	000121	584	015	0146	00021316
33	160	165	− 005	009	000081	160	0	− 0004	00000016
34	132	134	− 002	012	000144	130	002	0016	00000256
35	269	274	− 005	009	000081	266	003	0026	00000676
36	1 310	1 330	− 020	− 006	000036	1 290	020	0196	00038416
37	089	087	002	016	000256	084	005	0046	00002116
38A	692	700	− 008	006	000036	679	013	0126	00015876
38B	694	703	− 009	005	000025	682	012	0116	00013456
39A	694	683	011	025	000625	663	031	0306	00093636
39B	689	686	003	017	000289	666	023	0226	00051076
40A	644	647	− 003	011	000121	628	016	0156	00024336
40B	641	652	− 011	003	000009	633	008	0076	00005776
41A	549	554	− 005	009	000081	537	012	0116	00013456
41B	543	548	− 005	009	000081	532	011	0106	00011236
42A	196	246	− 050	− 036	001296	239	− 043	− 0434	00188356
42B	196	241	− 045	− 031	000961	234	− 038	− 0384	00147456
43A	440	448	− 008	006	000036	435	005	0046	00002116
43B	428	454	− 026	− 012	000144	440	− 012	− 0124	00015376
44A	336	353	− 017	− 003	000009	342	− 006	− 0064	00004096
44B	353	358	− 005	009	000081	347	006	0056	00003136
45A	2 128	2 134	− 006	008	000064	2 070	058	0576	00331776
45B	2 122	2 139	− 017	− 003	000009	2 075	047	0466	00217156
46A	428	437	− 009	005	000025	424	004	0036	00001296
46B	423	426	− 003	011	000121	413	010	0096	00009216
47A	235	246	− 011	003	000009	239	− 004	− 0044	00001936
47B	224	235	011	003	000009	228	− 004	− 0044	00001936
48A	333	336	− 003	011	000121	326	007	0066	00004356
48B	333	336	− 003	011	000121	326	007	0066	00004356
49A	126	154	− 028	− 014	000196	149	− 023	− 0234	00054756
49B	157	148	009	− 023	00529	144	013	0126	00015876
50	700	706	− 006	008	000064	685	015	0146	00021316
51	655	700	− 045	− 031	000961	679	− 024	− 0244	00059536
52	865	888	− 023	− 009	000081	862	003	0026	00000676
53	784	792	− 008	006	000036	768	016	0156	00024336
54	1 123	1 212	− 089	− 075	005625	1 176	− 053	− 0534	00285156
55	073	064	009	023	000529	062	011	0106	00011236
56	081	095	− 014	0	0	092	− 011	− 0114	00012996
57A	591	599	− 008	006	000036	581	010	0096	00009216
57B	594	602	− 008	006	000036	584	010	0096	00009216
58A	406	412	006	008	000064	400	006	0056	00003136
58B	420	428	− 008	006	000036	415	005	0046	00002116

TABLE I

COMPARATIVE VALUES BY STUDENT'S METHOD OF PERCENT CaO AS DETERMINED BY DYER'S MODIFIED AND CHAPMAN'S METHODS—Continued

No	Dyer's A % CaO	Chapman's B % CaO	A − B	D (A B + 014)	D²	C (9702B)	A − C	D (A − C − 0004 −)	(D)²
59A	409	412	− 003	011	000121	400	009	0086	00007396
59B	406	409	− 003	011	000121	397	009	0086	0007396
60A	185	193	− 008	006	000036	187	− 002	− 0024	00000576
60B	179	188	− 009	005	000025	182	003	− 0034	00001156
61A	428	431	− 003	011	000121	418	010	0096	00009216
61B	428	431	− 003	011	000121	418	010	0096	00009216
62A	140	140	0	0	0	136	004	0036	00001296
62B	140	137	003	017	000289	133	007	0066	00004356
63A	2 078	2 108	− 030	− 016	000256	2 045	033	0326	00106276
63B	2 078	2 108	− 030	− 016	000256	2 045	033	0326	00106276
64A	081	104	− 023	− 009	000081	101	− 020	− 0204	00041616
64B	092	109	− 017	− 003	000009	106	− 014	− 0144	00020736
65	107	118	− 011	003	000009	114	− 007	− 0074	00005476
66	182	184	− 002	012	000144	180	002	0016	00000256
67	196	202	− 006	008	000064	196	0	− 0004	00000016
68	362	370	− 008	006	000036	359	003	0026	00000676
69	070	070	0	0	0	068	002	0016	00000256
70	118	118	0	0	0	114	004	0036	00001296
Sum	40 752	42 005	−1 253		0 5581	40 748	004		00307783
Mean	448	462	− 014		00028		0004		00034

$$Z = \frac{014}{\sqrt{00028}} = 82 \qquad\qquad Z = \frac{0004}{\sqrt{00034}} = 022$$

Odds over 9999 1 Odds below 21

When both methods are statistically compared, Z = 82 and the odds from the table (9) are found to be over 9999 1 The odds indicate a real difference in the analytical results between the two methods, since according to the table odds over 21 1 indicate a significant difference in the results

The evidence suggests that Chapman's method tends to give higher results with a mean deviation of 014 per cent ± 0017 per cent in 91 determinations or values that may fluctuate between 0123 per cent and 0157 per cent For comparison purposes the results obtained by either method may be considered entirely satisfactory That either is as good as the other is corroborated by the excellent checks obtained by each method in the duplicate of different extractions for samples 31, 38–49 inclusive, and 57–64 inclusive The statistical interpretation, therefore, does not invalidate at all, Chapman's method.

Chances for personal analytical error are much less in the Chapman method since the work is greatly facilitated by the elimination of the cumbersome procedure required for the precipitation of Al, Ti, and P_2O_5 with NH_4OH in the Dyer modified method The former method saves about 66 per cent of the time required by the latter

Were it necessary to convert results obtained by Chapman's

method to those in terms of the Dyer modified method, it would be proper to multiply by the factor .9702. The value Z^1, after the application of such a factor to each result obtained by Chapman's method becomes .022, and the odds from the table are found to be below 2:1. The odds indicate that there is no significant difference between the analytical results of both methods Results indicate that the increase by Chapman's method tends to be constant. The mean deviation becomes now, .0004 per cent $\pm$ .0017 per cent or a fluctuation between —.0013 per cent and .0021 per cent which is extremely low.

Colorimetric Methods for Phosphoric Acid

Studies were made of the molybdate blue method with the modifications of Briggs and Doisy applied by Arrhenius (1) to citric acid extracts. The method is as follows:

"Ten cc of the citric acid extract are placed in a 100 cc volumetric flask and diluted to about 80 cc; 1 cc con. H_2SO_4, 5 cc ammonium molybdate (25 gms. ammonium molybdate dissolved in 300 cc. water) and then 200 cc dilute sulphuric acid (75 cc conc. H_2SO_4 filled up to 200 cc with water), 1 cc sodium sulphite (20 g. Na_2SO_3 + 80 cc water), and 1 cc hydroquinone (0.5 g. per 100 cc and one drop conc. sulphuric acid), are added. The flask is filled to the mark and the solution shaken. The color is, after 12 to 24 hours, compared with a standard series of solutions with known P_2O_5 content varying between .05 and 90 mgm. P_2O_5 per 100 cc." The so-called Arrhenius molybdate blue method for P_2O_5 determinations in citric acid extract is based on the one recommended by Bell-Doisy-Briggs (2) for P_2O_5 determinations in urine and blood, with the exception that the addition of trichloracetic acid for the precipitation of protein material is eliminated.

Although Arrhenius claims that results obtained are accurate below 0.50 mgm. P_2O_5 (.05 per cent P_2O_5 in the 10 cc citric acid aliquot used by us), our results were entirely inconsistent. The citrate ion colored by the presence of iron salts causes difficulty in matching the colors of the unknown and the standard in the colorimeter.

Studies were made of the method that Warren and Pugh (11) worked out at the Rothamsted Experimental Station based on the colorimetric determination of phosphoric acid in citric acid extractions of soils as follows:

"Seventy-five cc of the citric acid extract are pipetted into a 300 cc Kjeldahl flask, 10 cc conc. HCl added and followed by 12 cc of 20 per cent sodium permanganate. The sides of the flask are washed

down with a little water. After standing half an hour the contents are vigorously digested till no manganese precipitate remains (about ½ hr. more). The contents are transferred with a minimum amount of water to a 100 cc graduated flask; 4 cc of 10 per cent potassium ferrocyanide are added slowly, drop by drop, with frequent shaking. Several minutes later the mixture is titrated with 1:1 ammonia until the blue color just turns purple; 1.5 cc 2 N sulphuric acid are then added and made to the mark with water. After the solution has been filtered and the first few cc discarded, the color is developed in an aliquot by one of the following methods:

Fiske—Subbarrow (6) "10 to 50 cc are pipetted into a 100 cc graduated flask, diluted to 75 cc approximately, 10 cc of ammonium molybdate added, then 4 cc aminonaphthol sulphonic acid solution and the liquid made to the mark. The flask should be shaken during each addition. The contents are finally poured into a 100 cc conical flask; 15 minutes later the test compared with a standard phosphate solution".

Deniges (5)—"1 to 25 cc are pipetted into a 100 cc graduated flask, diluted to 90 cc, and 1 cc ammonium molybdate and three drops of stannous chloride solution added, the flask being shaken with each addition. After diluting to the mark the contents are poured into a 100 cc conical flask, and compared after 5 minutes with a standard phosphate solution".

Our results with the Warren and Pugh method were extremely low compared with those obtained by the usual Dyer method. This may be due to the adsorption of phosphates by the manganese ferrocyanide precipitate. Ward (10) states that "the ferrocyanide precipitate is difficult to filter, because of its colloidal condition and that the amount of phosphorous present in the sodium permanganate is of the same order of magnitude as that in the sample, and inaccurate results are certain to follow in the case of soils low in P_2O_5".

Lonstein (8) applied the method of Deniges, so widely used for water extracts, to citric acid extracts of a number of South African soils and obtained good agreement with the gravimetric method. His method briefly consists in evaporating a small volume of the citric acid extract to dryness after the addition of calcium acetate solution. The residue is ignited to destroy the organic matter and to render the silica insoluble, and then extracted with 10 per cent sulphuric acid. After filtration the excess of the acid is neutralized with ammonia and the color developed with ammonium molybdate and stannous chloride solutions.

Although we were favorably impressed by the Lonstein method we disregarded it because the figures obtained with it by Warren and Pugh (11) "reveal the presence of some disturbing factor in the analyses of the heavier soils used, especially when the Deniges method

of color production was used. The blue color developed slowly and had a green tint. The view was sustained that the sulphuric acid extracts from the clay soils contained appreciable amounts of ferric iron as the interfering constituents''.

One of the latest contributions to the subject on the colorimetric determination of phosphorus in citric acid extracts of soils is the work of Ward (10), chemist of the Experiment Station of the Hawaiian Sugar Planters' Association. Ward's procedure for the preparation of the citric acid extract is as follows: ''To 100 ml. of citric acid extract, add 50 ml. of concentrated nitric acid, 15 ml. of concentrated hydrochloric acid, and 10 ml. of 20 per cent sulfuric acid free from phosphorus and arsenic. Evaporate slowly till fumes of SO_3 are evolved. Take up in hot water and boil''. The iron is removed by electrodialysis into a special electrolytic cell. The color is developed by the method of Zinzadze as follows: ''Aliquots from the solutions of citric acid extract prepared for analysis are neutralized to the yellow end point of alpha—dinitrophenol indicator with 10 per cent ammonia solution. Dilute the solutions to 90 ml., add 1.4 ml. of molybdenum blue reagent (molybdic acid reduced by molybdenum metal in sulphuric acid solution), heat for 30 minutes on the steam bath, cool, and make up to exactly 100 ml. Employ a sensitive colorimeter for comparison with the standard solution''.

The work of different investigators reveal that the accurate colorimetric determinations of phosphoric acid in soils extracted with 1 per cent citric acid, demands attention on the destruction of the citrate ion, and of the soluble silicates and organic matter; the absence of large amounts of silica; the absence of phosphorous in the chemical reagents used; the elimination of the ferric ion; and a controlled acidity. Ward (10) calls the attention to the presence of titanium and to the use of colorimetric standards which are very close to the unknown in color intensity so as to reduce errors due to deviations from Beer's (12) law.

Treatments of the Citric Acid Extracts for the Phosphoric Acid Determinations

In view of the several difficulties that we encountered in obtaining accurate results with the application of colorimetric methods for the determinations of phosphoric acid in soils extracted with 1 per cent citric acid we proceeded to study the simplification of the chemical treatments given to such extracts in the Dyer modified method and then followed the official molybdate volumetric method for phosphoric acid.

Our first attempt was to precipitate directly phosphoric acid as ammonium phosphomolybdate in aliquots of the citric acid extracts. In some cases, good checks were obtained with the results by the Dyer modified method. In other cases, no precipitate was obtained; and in other cases, lower results were obtained. This may be explained on the basis that citric acid, extracts from certain soils, phosphates in organic combinations that are not precipitated by ammonium molybdate, and that the presence of the undecomposed soluble silicates may hold by absorption the phosphate ions in solution.

Our second attempt was to destroy the organic and silicate compounds by evaporation almost to dryness, with aqua regia. The residue was taken with a few cc of aqua regia, diluted with water, and filtered. Phosphoric acid was determined in the filtrate by the official molybdate volumetric method. Although our results checked much better with those obtained by the Dyer modified method we were unable to obtain the ammonium phosphomolybdate precipitate in several of the treated extracts. It seems that the aqua regia treatment was not drastic enough, in some cases, to decompose some of the silicates that would tend to establish a competition for the adsorption of the phosphate ions in solution.

Our next procedure was then to evaporate the citric acid extracts to dryness with aqua regia and ignite the residue at low temperature to destroy the undecomposed organic matter and complete the dehydration and destruction of silicates. This treatment served as a basis for our recommended procedure (see pp. 288–289). Analytical results are expressed in Table II.

Analytical Results of Percent P_2O_5 by our Short Procedure

All analyses by both methods were performed in the same extraction. The letters A and B following a sample number represent duplicate extractions. All the analyses by Dyer's modified method and by our short procedure in samples 18, 20 and 23–27 inclusive, were made by the same chemist, F. A. Villamil. All other analyses by our short procedure were made by the senior author. The values in columns A and B represent percent P_2O_5 obtained respectively by the Dyer modified method and by our short procedure. The values of column A–B are obtained by subtracting the values of column B from those of A. The values D represent the mean deviations. The number of determinations $n = 45$. The value Z represents the ratio of the mean of columns (A–B) to the square root of the mean of the values D^2. The statistical interpretation of the results were obtained with values Z and n in the Student's table modified by Love (9).

TABLE II

COMPARATIVE VALUES BY STUDENT'S METHOD OF PERCENT P_2O_5 AS DETERMINED BY THE DYER MODIFIED METHOD AND OUR SHORT PROCEDURE

No	Dyer's A % P_2O_5	Short Procedure B % P_2O_5	A—B	D (A—B—0003)	D^2
1A	014	016	— 002	— 0023	0 000529
1B	014	015	— 001	0013	00000169
2A	010	009	001	0007	00000049
2B	010	009	001	0007	00000049
3A	003	003	0	— 0003	00000009
3B	003	003	0	— 0003	00000 09
4A	007	007	0	- 0003	00000009
4B	007	007	0	— 0003	00000009
5A	013	011	002	0017	00000289
5B	013	010	003	0027	00000729
6A	005	005	0	— 0003	00000009
6B	004	006	— 002	— 0023	00000529
7A	002	004	— 002	— 0023	00000529
7B	002	005	— 003	— 0033	00001089
8A	017	017	0	— 0003	0000009
8B	015	017	— 002	0023	00000529
9A	006	008	— 002	— 0023	00000529
9B	007	006	001	0007	00000049
10	018	017	001	007	00000049
11A	036	039	— 003	— 0033	00001089
11B	036	039	— 003	— 0033	00001089
12A	146	148	— 002	— 0023	00000529
12B	115	155	— 010	— 0103	00010609
13A	023	015	008	0077	00005929
13B	023	014	009	0087	0007569
14A	013	013	0	— 0003	00000009
14B	013	013	0	— 0 03	0 000009
15A	019	016	003	0027	00000729
15B	019	016	003	0027	00000729
16A	023	025	— 002	— 0023	0000 529
16B	023	025	— 00	— 0023	00000529
17	003	002	001	0007	00000049
18	023	020	003	0027	00000729
19A	052	054	— 002	— 0023	00000529
19B	051	053	— 002	— 0023	00000529
20	033	038	— 005	— 0053	00002809
21A	0 9	013	006	0057	00003249
21B	018	013	005	0047	00002209
22A	005	004	001	0007	00000049
22B	006	004	002	0017	00000289
23	004	001	003	0027	00000729
24	008	005	03	0027	00000 29
25	007	005	002	0017	00000289
26	002	001	001	0007	00000049
27	004	002	002	0017	00000289
Sum	924	908	016		00047045
Mean	0205	0202	0003		0000105

$\sqrt{0000105}$

Odds Below 3 1

When both methods are statistically compared, Z = 09 and the odds from the table (9) are found to be below 3:1 The odds indicate that there is no significant difference between the analytical results obtained by both methods.

That either method is as good as the other is corroborated by the excellent checks of the duplicates in different extractions

Chances for personal analytical error are much less in the short

procedure since the work is greatly facilitated by the elimination of the cumbersome procedure required for precipitation of Fe, Al, Ti and P_2O_5 with NH_4OH in the Dyer modified method. The former method saves about 30 per cent of the time required by the latter.

POTASH

Several modifications for the Dyer modified method were tried. Our results were unsatisfactory. We recommend the Dyer modified method with the following modification: Precipitate the lime together with the iro nand phosphoric acid. (See pp. 289–290).

Through the courtesy of Dr. W. W. G. Moir, agricultural technologist of the American Factors, Limited, Hawaii, and L. E. Davis, associate chemist of the Experiment Station of the Hawaiian Sugar Planters' Association, we obtained a reprint of Gow's (7) work on a rapid colorimetric method for the determination of potash. "This method consists essentially of precipitating potassium chloroplatinate by means of its insolubility in alcohol, dissolving the precipitate in water and developing a color by the addition of stannous chloride. The intensity of the yellow color thus produced is directly proportional to the amount of platinum present in the precipitate and hence to the amount of potash present."

SUMMARY

Research was undertaken with the purpose of shortening time without affecting accuracy of the Dyer modified method for the determination in soils, of phosphoric acid, lime and potash soluble in 1 per cent citric acid solution.

A short method is recommended for the lime determination based on the Chapman's method (4) for the precipitation of calcium oxalate in acid solutions (pH 3.9–4.2) in the presence of iron, aluminum, titanium, manganese, magnesium and phosphates. A short method is recommended for the phosphoric acid determination. Results are analyzed statistically by Student's method. Several of the colorimetric methods recommended for the phosphoric acid determination are also discussed.

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A VARIETY OF TOBACCO RESISTANT TO ORDINARY TOBACCO MOSAIC

By J. A. B. NOLLA, JOHN SIMON GUGGENHEIM Memorial Foundation Fellow, 1932–33, University of Wisconsin; and ARTURO ROQUE, Assistant Phytopathogist, Insular Experiment Station, Puerto Rico.

The ordinary mosaic of tobacco affects a wide range of solanaceous hosts including most members of the genus Nicotiana. It is particularly severe on all varieties of *Nicotiana tabacum* L. heretofore studied in relation to the disease. In spite of the common occurrence of this virus disease on *N. tabacum* and the unusual opportunity afforded for the recognition of varietal or strain resistance to the disease, no such development has apparently been reported. Furthermore, the economic aspects of control of this malady are of such a nature that plant pathologists must have been on the lookout for cases of resistance to the disease for many years.

In the summer of 1929 the senior author visited the Cauca Valley of Columbia, South America. In these trips he observed several varieties of commercial tobacco, and his interest was curiously drawn to two varieties, seed of which was introduced into Puerto Rico. This seed obtained from Señor Carlos Rivera G., of Palmira, Department of Valle del Cauca, was presumably from the same stock of which plants were seen grown at the Santa Ana Farm of the Compañía Colombiana de Tabaco. The exact location is near the southeastern limits of the Department of Valle del Cauca.

The two varieties were grown in Puerto Rico, near Caguas, in 1929–1930 and it was during that year that the senior author observed the almost complete freedom from mosaic in one of the varieties, namely, the *Ambalema*. In a population of some six hundred plants, four individuals showed the disease as evidenced by a slower growth and by the characteristic symptoms on leaves. Unfortunately, no further studies were made with the susceptible plants. Selection of resistant plants was made from that progeny and crosses between these and a susceptible variety begun that year.

The senior author left Puerto Rico in the summer of 1930 and his studies were delayed for one year while doing graduate studies at Cornell University. He resumed this investigation in the fall of 1931.

In the meantime, the junior author, working at the Insular Experiment Station of Puerto Rico, discovered, independently, the resistance of this variety of tobacco to mosaic.

Both authors are now engaged in a study of the inheritance of resistance to mosaic. Our observations show that most plants of this variety inoculated with the virus of the ordinary tobacco mosaic do not exhibit any very marked symptoms. However, a clearing of the veins may be noticed in some individuals, while a smaller percentage exhibit chlorotic areas of a mild type, in the intervenal regions of the blade of the leaf.

Since the genetic nature of the resistance of this variety of tobacco was not well understood, an earlier note had seemed unwarranted. An explanation for the cases of susceptible individuals would have been desirable before publishing any note on resistance of the variety to mosaic. The senior author, in his annual report to the Chief Pathologist [See Cook (2)] in 1930, said concerning this variety:

. . . . "of the Colombian varieties one proved to be very promising", Page 97. Quite intentionally no mention is made of any specific quality.

Knowledge that the planting of this variety of tobacco is being extended in some places of the Island has prompted the writers to release this preliminary note. We wish to make it clear at this time that we are not responsible for the distribution among farmers of a variety of tobacco which has not yet been submitted to adequate selection and testing.

The senior author wishes to call attention to the fact that at the time the tobacco was collected in Colombia, no observations of resistance to mosaic were made. Our notes on prevalence of mosaic on the various farms rather showed that the variety was apparently susceptible. That we failed to detect freedom from symptoms of mosaic at that time may be explained in two ways. Either the mosaic of tobacco of that part of the continent is more virulent than the mosaic of Puerto Rico and the United States; or, as is most probable, the plants represented a very heterozygous population in which the susceptible individuals predominated. It is of interest, that in a small planting in Toro, Colombia, inspected on June 11th, no mosaic was observed even in plants a year old. No particular significance was attached to this observation at that time, and it was believed that such freedom from mosaic was the result of good cleaning of seed and careful handling of beds and seedlings.

The first illustrative record of this variety of tobacco, as far as the authors know, appeared in 1930 in a Puerto Rican publication (3). That picture was taken by the senior author near Toro, on June 11th, 1929. This town is located in the northern part of the Depart-

ment of Valle del Cauca. In this locality, however, the name given to the variety is "Pájaro Negro" (black bird). A plant of the first Puerto Rican grown tobacco of this variety is illustrated opposite page 97, Annual Report of the Insular Experiment Station of Puerto Rico, 1929–30. Bunker (1) publishes a figure of a "Variedad Colombiana Seleccionada y Aclimatada por el Especialista . . ." (Colombian variety selected and acclimated by the Specialist) . . ." Bunker obtained seed from our experimental plots of 1929–30 and, therefore, his plant must have been photographed the following season.

Doctor Carlos Durán Castro, formerly Director of the Agricultural Station at Palmira and now Chief of the Department of Agriculture in the Ministerio Nacional de Industrias at Bogotá, accompanied the senior author in most of his trips, being a source of constant encouragement. His courteousness on the one hand, and his devotion to our work, on the other, more than compensated for our efforts. He should have a considerable share of whatever credit may be reaped from the discovery of this important tobacco variety. The Hon. Carlos E. Chardón, formerly Commissioner of Agriculture of Puerto Rico and now Chancellor of the University of the Island, head of the Agricultural Mission to Colombia in the summer of 1929, also deserves our recognition for his valuable cooperation.

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THE PINEAPPLE DISEASE OF SUGAR CANE IN PUERTO RICO

By Melville T. Cook, *Plant Pathologist*,
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This disease is caused by *Thielaviopsis paradoxa* (De Seynes) von Höhn and is widely distributed throughout the cane-growing parts of the world. This fungus was found first on pineapple in 1886 by De Seynes, who described it under the name of *Sporochisma paradoxum*. In 1892 Saccardo referred it to *Chalara paradoxa* (De Seynes) Sacc. In 1893 Went reported *Thielaviopsis ethaceticus* as the cause of a serious disease of sugar cane in Java. In 1904 von Höhnel reported that the organisms described by De Seynes and by Went were the same and made the combination *Thielaviopsis paradoxa* which has been very generally accepted from that time to the present. Dade (1928) (4) reported the finding of a *Ceratostomella* which he believed to be the perfect stage of the fungus which would become *Ceratostomella paradoxa*.

The fungus has been reported as attacking a large number of species of plants—sugar cane, pineapple, plantain, mango, coconut, date palm and many others. It has been reported from nearly all the countries in which sugar cane is grown. The geographical distribution according to the International Survey of the Disease of Sugar Cane (3) with a few additions, is as follows: Argentina, Australia, British Guiana, Ceylon, Colombia, Cuba, Dutch East Indies, Fiji, Formosa, Gold Coast, Hawaii, India, Jamaica, Java, Lesser Antilles, Madeira, Mauritius, Malaya, Mexico, Philippines, Portuguese East Africa, Puerto Rico, Reunion, Santo Domingo and Southern United States. It is reasonable to suppose that it occurs in all the other sugar-cane-growing countries. In Puerto Rico this fungus attacks the pineapples and is sometimes the cause of heavy losses in fruits and in young slips which have been planted for a short time. It attacks the coconuts and is sometimes the cause of the falling of a large number of young fruits and sometimes attacks the buds, causing a deformity of the young leaves and a slow dying of the trees. It attacks sugar cane, causes a rotting of seed cuttings and poor germinations, which will be described in this paper.

Went (1893) in the first record of this fungus attacking sugar cane stated that it was the cause of a serious disease. Some of the

records since that time have indicated that it was serious while others have indicated that it was of little or no importance. Johnston (7) conducted experiments in Puerto Rico which were published in 1913 for the purpose of determining the relative resistance of a number of varieties. In these experiments he punched a hole in the end of the seed cutting and injected the fungus with a 10 cc syringe. He reports injuries ranging from 15 to 90 per cent but none of the varieties used by him are of commercial importance on the island at this time. He also conducted experiments for the control of the disease and reported that best results were obtained by treating seed cuttings with 4–5–50 Bordeaux and by sealing the cut ends with tar.

When the writer came to Puerto Rico in 1923, inquiries were made concerning the problems of germination. All reports indicated that poor germination was rare and that when it did occur that it was due to poor seed cuttings. Other problems required the time of the writer and no further consideration was given to the problem of poor germination until the spring of 1930 when our attention was called to very poor germination in one locality. A personal examination showed that the soil was heavy and poorly drained and that the seed cuttings were rotting as a result of attacks of *Thielaviopsis paradoxa*. Experiments were started on a small plot of ground at the Experiment Station and have been conducted over a period of three years.

The method consisted in the planting of fifty seed cuttings each of some of our most important varieties, using pieces with three eyes and allowing them to grow for six to twelve weeks. At the end of the time, they were lifted and the germinating eyes counted. In order to make sure of uniform inoculations, the fungus was grown in large flasks and put into a bucket of water. The canes were dipped in this mixture just before planting. After a time, the soil was so thoroughly infested that this was unnecessary. This was demonstrated by treating one half of the cuttings in one planting. When the young plants were lifted and the germinating eyes counted, the results were practically the same for the treated and untreated cuttings. Eleven crops were grown. The soil became so heavily infested as a result of repeated use for this work that the germination of the last three crops was very low. The varieties used were B.H.–10(12), S.C.–12(4), Uba, P.R.–801, 803, 807, 809, 820, 826, Co.–281, F.C.–916, P.O.J.–2714, 2725, 2727 and 2878. The work has not been altogether satisfactory because it was impossible to control the environmental factors in field experiments. One planting was damaged by the overflow of the river and the data very unreliable. However, the results are of some value. These results may be summarized as follows:

1. The so-called pineapple disease of sugar cane in Puerto Rico which is caused by a fungus (*Thielaviopsis paradoxa*) is occasionally very severe.

2. It is most severe on heavy, clay, poorly drained soils.

3. It is most severe during the cooler months of the year.

4. During the summer months the fungus appears to be more abundant or more active in the higher elevations (up to 2000 ft.) than in the coastal plains.

5. In heavily infected soil the rotting of seed cuttings may be as great during dry as during rainy weather, if other conditions are favorable.

6. With two exceptions, the germination tests were below 50 per cent. Both exceptions were with Co.–281. The average germination in Puerto Rico is about 70 or 75 per cent according to experienced cane growers who have been consulted by the writer.

7. Co.–281 proved to be most resistant with other varieties in the following order: P.O.J.–2878, P.R.–801, P.R.–803, P.R.–826, Uba, B. H.–10(12), P.R.–820, P.R.–807, F.C.–916, P.O.J.–2725, S.C.–12(4), P.O.J.–2714, P..R.–809, P.O.J.–2727.

Symptoms

The fungus has been recognized as a wound parasite for many years. It penetrates the cut ends of the seed pieces and destroys the cell walls of the parenchyma tissues. The first evidence of an attack by this fungus is a reddish discoloration of the tissues, followed by a black color and by decay. The decay is accompanied by an odor which is very similar to that of pineapples which are rotted by this fungus. When the decay is well advanced, if one will cut through the rind and break a cane the fibro-vascular bundles can be pulled out in mass like the hairs of a brush.

No studies were made on the temperature relations but Klotz and Fawcett (8) state that the optimum temperature for this fungus on the date palm is 24 to 27½ degrees C. This is approximately 64.5 to 67.5 degrees F. which is a little lower than the temperature of our coastal plains during the winter months.

Treatments

Severe outbreaks of this disease in Puerto Rico are so rare that it is not necessary to use a treatment very often. However, severe outbreaks are likely to occur at any time on poorly drained soils, es-

pecially during the winter months. These outbreaks are expensive in proportion as they make replanting necessary. The first and most important treatment is a well-drained soil. In case of heavily infected soil it may be desirable to plant some other crop for a season or to use the Bordeaux treatment. This must be decided by the grower on basis of farm management and economics. In case the Bordeaux treatment is used, the cane should be treated very soon after cutting. If the seed cuttings become infected before treatment, the treatment is useless. When the grower has a few cuttings of a new variety, it is advisable to protect them by dipping the cut ends in tar or melted paraffin.

The Three-bud Seed Piece

The Puerto Rican practice is to use three-bud seed cuttings. This practice is no doubt the result of long years of experience and the writer believes that the *T. paradoxa* has been the deciding factor in favor of this method. Experimental work by the writer and others has demonstrated that there is a higher germination with three-bud cuttings than with cuttings of two buds or one bud. This is probably due to the length of the seed pieces rather than to the number of buds. In a long seed cutting the fungus has to travel a much longer distance than in short seed pieces and the buds have a better chance to germinate and become established before the fungus reaches them. The writer has found that when short seed cuttings for experimental studies are planted in unsterilized soil, it is advisable to dip the cut ends in melted paraffin or tar.

Other Causes of Poor Germination

Marasmius sacchari is one of the minor causes of poor germination in Puerto Rico. In one planting of one variety, this fungus killed 20 per cent of the buds.

Other causes of poor germination that have been reported from other countries are *Colletotrichum falcatum* and *Melanconium sacchari* in Louisiana, *Ceratostomella adiposum* in India and *Lasiodiplodia theobromae* in the Philippine Islands.

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WHITE SPOT OF PINEAPPLES

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This disease was reported from Puerto Rico by G. L. Fawcett of the Porto Rico Agricultural Experiment Station (Mayagüez) in 1908, who described it as follows:

"The pineapple has one conspicuous disease characterized by the appearance of white spots on the leaves. This is caused in many cases at least by the entrance of organisms through wounds such as the punctures made by sucking insects. At first the spots are small and brown. Gradually they enlarge, the epidermis sinks, the interior tissue is destroyed, and the white bleached appearance is taken on. It is in no sense a serious disease although common under excessively moist conditions."

Nowell (1922) says:

"A leaf-spot which is fairly common in the West Indies has been investigated by L. D. Larsen in Hawaii. It occurs on well-grown plants and its effect on their development is not usually appreciable. It has been shown to be due to the infection of insect and spine punctures, or other injuries, by the fungus Thielaviopsis. Infection and development depend on the prevalence of moist and cloudy weather or on the shading of the plants."

Larsen of Hawaii published a bulletin on diseases of pineapples in 1910 in which he described what appears to be the same disease as follows:

"The spots vary considerably, as regards size, shape and color. Many are large and white, and are noticeable from along distance, while others are small and inconspicuous. In typical mature spots there is a straw colored central area surrounded by a dark margin. Very often there is a dark center within the straw colored area, or dark blotches, due to the formation of the black macrospores within the tissue, may be scattered over it in an irregular manner. Sometimes long white arms extend beyond the dark border, and, again, the entire spot may be white or straw colored throughout. The internal tissue is soft and decayed at first, but this soon dries out, leaving the injured area dry and shrunken. The white or straw-colored area is not due simply to drying of the affected tissue, as is often the case with similar diseases, but comes on while the tissue is still quite firm, and long before it has begun to dry out. In early stages the spots may be olive brown in color and fairly regular in outline, or they may be white and irregular from the start. The size of the spots increases very rapidly, so that in two or three days what was a small brown spot will have become from two to six inches in length. Even twelve inches is not an unusual length."

Larsen believed these spots to be due to *Thielaviopsis paradoxa* which gained entrance to the plant through slight wounds. He said:

"The fungus, Thielaviopsis, which as we have seen causes Soft Rot of the pineaple fruit and Base Rot of the cuttings, is also responsible for a conspicuous disease of the leaves of this plant. It attacks the leaves through surface wounds made by insects and by the spines and sharp edges of neighboring leaves, and produces large discolorations or spots which often spread across the entire leaf and thereby kill all that part of the leaf which is above the spot. The spots may be found in almost any of our pineapple fields during the winter months, and at times become exceedingly numerous. They are most prevalent in the finest fields where the plants are green and vigorous, while in poor fields and on yellow plants they are more rare."

He conducted experimental work on which this conclusion was based and which demonstrated that the fungus could not gain entrance to the plant except through wounds. He also made very interesting studies on the influence of weather which he described as follows:

"In the infection experiments conducted it was found that when inoculations were made in the presence of bright sunlight, or if the leaves were exposed to sunny and dry weather conditions on the following day, but very few of the inoculations would take. It was therefore necessary when inoculating leaves under such conditions to cover the wounds with grafting wax or paraffin. When the plants were shaded or when cloudy weather existed after inoculation, infection took place very readily without such protection. Direct sunlight prevents infection; first by drying out the wounds, and secondly, by killing the spores of the fungus. In the experiment mentioned on page 15 it was found that the most resistant form of Thielaviopsis spores are killed in a few hours when exposed to direct sunlight. With this in view it is evident why the spots are scarcely known during the dry summer season and yet become very numerous in the winter months.

"The size of the spots is also governed largely by weather conditions. Sunlight and dry weather, after infection has taken place, tend to limit the size while moist and cloudy weather has the opposite effect. In our infection experiments when the plants were well shaded the entire leaf would often become involved.

"It was furthermore noted that the typical white condition would make its appearance only on leaves that were exposed to sunlight. When inoculated plants were kept in the shade the spots would invariably be brown in color and very regular in outline, whereas when exposed to sunlight the white and irregular patches would appear. They appeared, however, in a sporadic manner, occurring on one leaf here and another there, while other leaves inoculated at the same time and equally exposed would show none of it. It was at first thought that this white appearance was a distinct trouble due to some cause other than Thielaviopsis, but judging from the results of our infection experiments such does not appear to be the case."

A very pronounced outbreak of this disease in the vicinity of Co-

rozal was called to the attention of the writer in August of 1932. These plantings were at an elevation of about 350 or 375 feet and on the boundary line between limestone soils of the coastal plain and the volcanic acid soils.

There had been heavy rainfall and the disease appeared in such abundance that the grower became very much alarmed. The fungus (*Thielaviopsis paradoxa*), which is well known as a parasite on a number of species of plants in Puerto Rico, had been reported previously to the writer as the cause of a very serious fruit rot in this locality. The symptoms, the weather conditions and the presence of the fungus, conformed with Larsen's Hawaiian report of 1910.

A large amount of the diseased leaves were collected and taken to the laboratory for study. A study of free-hand sections did not show a fungus. A large number of cultures were made but the fungus did not develop in any of them. *Thielaviopsis paradoxa* grows readily in culture and the writer has isolated it many times from decaying pineapple fruits, slips, sugar cane, coconuts and other plants, using the same medium as was used at this time. Material was then prepared for paraffing sectioning and staining but the results were again negative. It was impossible to conduct inoculation work at the Experiment Station, owing to lack of plants.

When the rainfall was reduced and bright sunshine prevailed for a few days, no new spots were formed. This was followed by another period of rainy weather and another outbreak of the disease. Therefore, it appears from these studies that these spots may be the results of weather conditions without the influence of any other agency. Field studies by the writer did not indicate that a puncture by a spine, insect or any other agency was necessary for the formation of these spots.

PATHO-ANATOMY OF ROOTS ATTACKED BY NEMATODES

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Very little study has been made in America of the anatomy of plants attacked by nematodes since the publication of Atkinson's "Nematode Root-Galls" (1) in 1889. During the past few years the writer has devoted some attention to this subject and the data on the dicotyledonous plants will be presented in this paper. The plants used in these studies were tomato, tobacco and ornamental Coleus. The results were the same in all cases and it would have been impossible to distinguish them except for the labels. The galls were caused by *Heterodera marioni* (Cornu) Goodey (= *Heterodera radicicola* Greeff).

The nematodes attack the very young roots The writer is of the opinion that they rarely, if ever, attack roots more than one millimeter in diameter. Young roots contain a large amount of tissue that is capable of division when stimulated. This includes the cambium, cortex and medullary rays. The parasites penetrate into the cortex and the rays where they stimulate an excessive growth. The writer is of the opinion that they rarely if ever penetrate into the fibrous or tracheary tissue.

All cells that retain the power of division are stimulated by the parasites. This stimulation results in the formation of a large number of very small cells in close contact with the parasite while those a distance are much larger (Figs. 3 & 5b). When the nematode attains full size the stimulation appears to cease and the cells become larger (Fig. 4b). The parasite does not appear to stimulate cell division or growth in the fibrous or tracheary tissues, but does push them out of the normal position. The parasite also causes the formation of tracheary tissues from and in the parenchyma tissue (Fig. 1b.)

Nematodes in the axis cylinder (Fig. 2) penetrated through the parenchyma cells and not through the fibrous or traeheary cells

The writer is inclined to believe that galls may be reinfected many times and that reinfection accounts for the larger galls. The tissues of a gall are highly meristematic as a result of stimulation by previous infections and are very favorable for reinfections. The tissues of the large galls are in such a state of confusion resulting from the large number of parasites and the reinfections that a histological

study is of little or no value. Any satisfactory study of the development of these galls should begin with the very young galls.

Atkinson's studies evidently were made on the galls that were advanced to a point where it was impossible to determine the incipient characters, but his description and discussion are very interesting. He said:

"The worms locate preparatory to passing into the cystic state at various depths in the tissues of the root. They are not confined to any particular tissue element or system but locate in the vascular tissue of the central cylinder, the cambium, parenchyma or even in the bark so that the body of the mature female cyst is frequently only protected by a thin layer of the dead peripheral tissue, or sometimes is even exposed. They seem to flourish better, however in or near the softer tissues of the root. It is a very common thing to find dead undeveloped female cysts, the majority of which I have always found in the woody tissue of the central cylinder. Possibly surrounded as they are by the harder, more compact tissue there is less certainty of the male reaching them for fertilization. This, however, is only a suggestion. I have not demonstrated it. All of the tissue elements in the diseased roots undergo hypertrophy, while some of them are subject to special changes in form as well as direction of growth.

"The parenchyma cells which normally have their tangential diameter greater than the radial are so changed that the radial diameter is the greater. This change in form of the parenchyma cells seems to obtain in nearly all of the parenchyma in the gall whether very near a cyst or distant from it. The increase in number of the wood and vascular cells of the central cylinder takes place though the cyst may not be located in or very near it. In such cases the fibres and ducts have their normal longitudinal direction. But if a cyst is located in or very near the central cylinder the ducts are turned in their direction of growth perpendicular to the axis of the root, bent around the cyst and then converge on the peripheral side, when, left, without any controlling influence over their direction of growth they often perform very curious evolutions through the parenchymatous tissue in all directions."

My results are not altogether in harmony with those given by Atkinson. Some of the nematodes stop in the cortex of the roots while others penetrate to the center of the axis cylinder which makes it necessary to consider the action of the nematodes on these two sets of tissues.

The writer agrees with Atkinson in the statement that the nematodes are found in all the tissues of the galls but as a result of studies on very young galls, the writer is of the opinion that the galls originate in the very young roots and at a period when most of the cells have retained the power of division. The writer is very doubtful if the parasites ever penetrate into the fibrous and tracheary tissues. The galls appear to originate in the young cortical tissues. As a result of the irritation by the parasites the fibrous and tracheary

tissues in the axis cylinder become distorted and sometimes displaced; new fibrous and tracheary tissues are formed in the cortical regions.

The size and shape of the galls depends primarily on the number of parasites in the roots and to some extent on their position in the roots and the age of the roots at time of infection. The writer is of the opinion that roots of more than one millimeter are rarely if ever infested.

The writer disagrees with Atkinson in his statement that "all the tissue elements in the diseased roots undergo hypertrophy". There is no hypertrophy of the tracheary tissue but new tracheary tissue is formed from the cortex. The writer also disagrees with Atkinson's statement that "the parenchyma cells which normally have their tangential diameter greater than the radial are so changed that the radial diameter is the greater". This statement is sometimes true especially in the very large galls which contain a large number of the parasites.

There is an enlargement of the roots due primarily to the excessive division and growth of the cells of the cortex. In most cases these cells are only slightly modified. Those next to the nematodes are somewhat smaller than normal. The larger cells may be slightly shorter (i. e. isodiametric) than in normal roots.

The cells in the axis cylinder do not increase in number but are pushed out of place by the growing nematodes.

There is a tendency for an increase in the amount of tracheary cells at the expense of the fibrous cells. Sometimes the axis cylinder is supplanted by the nematodes.

One part of an axis cylinder may be distorted and the other part normal.

The final result of the stimulation by the parasite is great masses of cells, the formation of new fibrous and tracheary tissues which are intermingled in the parenchyma in an irregular manner.

Atkinson compared the nematode galls with those caused by *Plasmodiophora brassicae* as follows:

"But if we take a thin transverse section of an enlarged root of each and compare them all resemblance vanishes. In a cross section of 'club foot' the first thing to attract attention is the great number of yellowish plasmodia, or else the spore masses within large cells, distributed all through the tissues. If the section is from an enlargement of a lateral root, unless very large, there will be little else to attract the attention when compared with a healthy root unless it be a slight enlargement of some of the other cells. The general char-

acter of the root structure is but little changed. The tracheral tissue of the axis cylinder, but little attacked is arranged in the same stellate form which we find it in a healthy root. The ducts, even when immediately in contact with cells containing plasmodia, are not turned from their longitudinal direction, or if so only slightly. The cells are not elongated and curved around the enlarged cells containing the plasmodium, but resemble the normal arrangement of small cells around a large one. Nor is the radial diameter of the parenchymatous cells proportionately increased, but if the cells are enlarged it is usually a proportionate or nearly symetrical enlargement.''

The above comparison is very satisfactory for a comparison of sections of galls well advanced in their development. However, comparisons of the old galls are of very little value. Comparisons of young galls would no doubt give us some information concerning the developmental history. The writer has not had an opportunity of studying the *Plasmodiophora brassicae* galls but judging from the description of the histology by Lutman (2) and Kunkel, (4) they are much more simple in structure than the galls caused by nematodes. Lutman said:

''The difference between the cross sections from a healthy root and those from a diseased one lies in the presence in the greatly hypertrophied cells of the cortical parenchyma of an opaque, colorless, finely granular plasma. The cortex is greatly increased in size and this enlargement is due to an increase in the number of the cells as well as to hypertrophy of the individuals. The vessels are often bent and shoved out of their proper position in diseased roots, but, as in normal ones, only contain air. The hypertrophied cells become filled in the older roots with small round spores of the organism to which Woronin gave the name of *Plasmodiophora Brassicae.*

Kunkel does not give us the history of the development of the very young galls caused by *P. brassicae,* but he said:

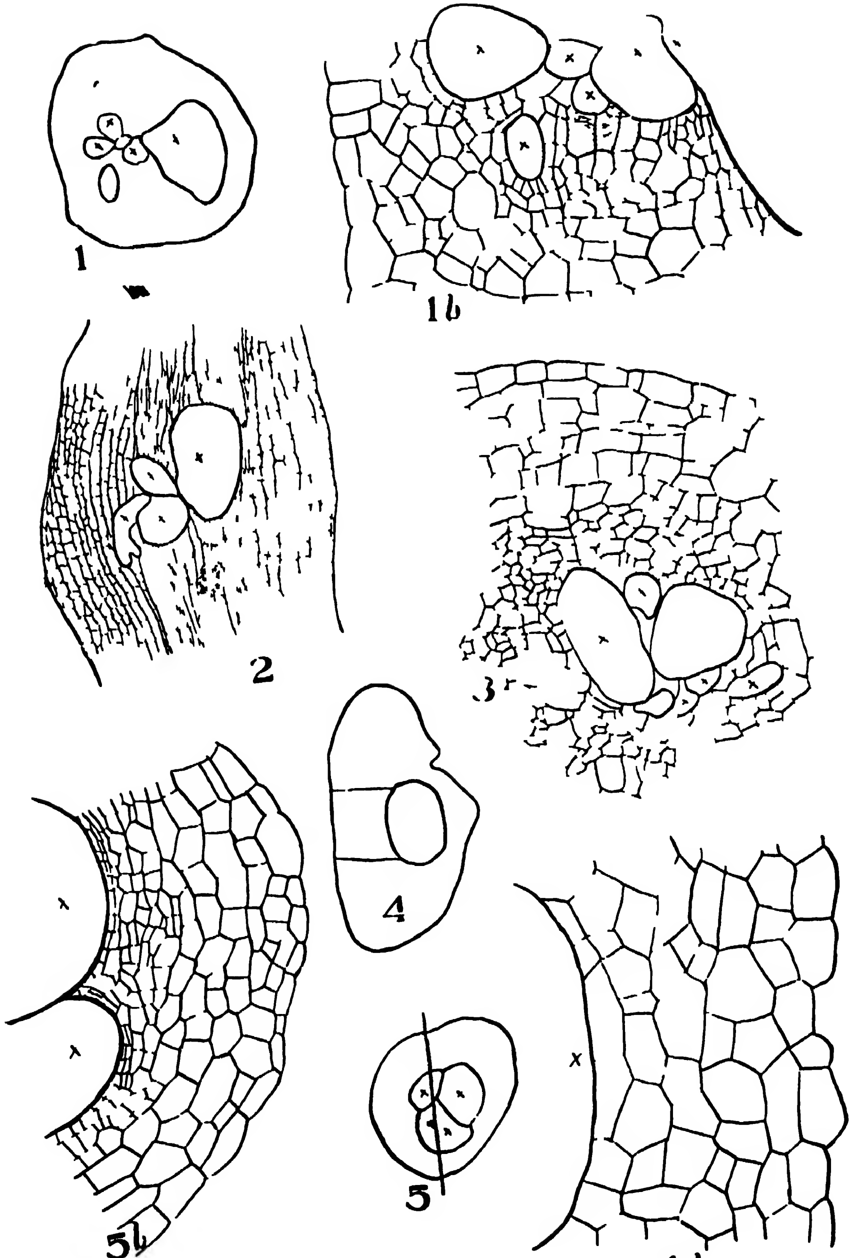
''Many of the host cells are very much enlarged, especially near the point of original infection. During the sixteenth and seventeenth days the parasite spreads still farther into the healthy tissues of the stem. It has not penetrated very much deeper, however, and does not seem to be able to attack the woody parts, at least to any very considerably extent.

''While the thickening of the cortex is accomplished more by cell growth than by cell multiplication, the swelling in the cambium region is brought about largely by an increase in the number of cells.''

He also stated that the cambium contributed to the enlargement, that the cortex grew, that the cortical cells were enlarged while those of the cambial region were small and that the parasite penetrated the rays and stimulated the cells so that the bundles were forced apart.

It appears to the writer that the galls resulting from nematodes are much more complex than the galls caused by *P. brassicae.*

PLATE XXIII



Summary

1. Root galls caused by nematodes (*Heterodera marioni*) originate as a result of attacks on meristematic tissues of very young roots.

2. The parasite may locate in the cambium or cortex or penetrate in the medullary rays.

3. There is no evidence that the parasite can attack fully formed fibrous and tracheary tissues or that it can stimulate their growth, but it can push them out of place.

4. The cambium, cortex and medullary rays are stimulated to excessive cell division and tracheary tissue is formed in the cortex.

5. The cells next to the parasites during the period of gall formation are very small as a result of excessive cell division while the more remote cells are much larger.

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Explanation of Plate

Fig. 1. Cross section of small root showing location of nematodes.

Fig. 1 *b*. Part of same showing the effect on the cells.

Fig. 2. Longitudinal section of small root showing location of nematodes.

Fig. 3. Cross section of a root showing location of nematodes. Note there is no tracheary tissue.

Fig. 4. Cross section of a root. Note there is no tracheary tissue.

Fig. 4 *b*. Part of same. Note the enlarged parenchyma cells.

Fig. 5. Cross section of small root. Note there is no tracheary tissue.

Fig. 5 *b*. Part of same. Note the parenchyma cells.

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MELVILLE T. COOK, Editor

PARTIAL BIBLIOGRAPHY OF VIRUS DISEASES OF PLANTS

José I. Otero and Melville T. Cook

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PARTIAL BIBLIOGRAPHY OF VIRUS DISEASES OF PLANTS

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and
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This bibliography was started independently by the two authors for their own personal uses. Upon learning that both were working on the same project, it was decided to combine our efforts and publish the combined manuscripts, hoping that the work would be of value to other students of virus diseases.

Many difficulties were met with in compiling this work. Some of which may be summarized as follows:

1. There are some errors in the many bibliographies that have been published in connection with the numerous papers on this subject. When these errors have come to our attention they have been corrected.

2. There are many short papers of little or no value but it has not always been possible to decide judiciously just which ones should be retained. No doubt we have made many injustices in deciding questions of this kind. Many anonymous papers and many Agricultural Experiment Station Bulletins of a popular character have been omitted. Reports of Directors of Agricultural Experiment Stations which do not include new data have been omitted in most cases. The publications of the Plant Disease Survey of the U. S. Department of Agriculture contains many records which are of value for estimates of losses and for geographical distribution in the United States. Most of these have been omitted unless they contain new records of hosts.

3. Many old papers which are of no value except as historical records have been omitted. Such papers are usually listed in recent publications on virus diseases. For example, the recent paper by Mc Kay and Warner on "Historical Sketch of Tulip Mosaic or Breaking. The Oldest Known Plant Virus Disease" contains many

historical record of this disease which have omitted from this bibliography.

4. Many errors have crept into the literature because the people making the citations did not understand the Spanish system of the names of persons. According to the Spanish system a person carries the names of the two parents; e.g. Rafael Menéndez Ramos. The first is his given name, the second is the name of his father and the third the name of his mother. He should be cited as Rafael Menéndez or as Rafael Menéndez Ramos, but never as R. M. Ramos as occasionally appears. We find him cited by both methods.

5. There is some difference of opinion as to the cause of certain diseases; some workers believing them to be due to viruses and other workers believing them to be due to other causes. Among these diseases may be mentioned the diseases of pecans. The carnation yellows has not been proved to be a virus disease but the symptoms are of such character that we have inserted the references. Recent papers give evidence that the bitter pit of the apple is caused by a virus but our work on the bibliography was so far advanced that we have inserted only a few of the references.

The compilers intend to follow as closely as possible the following features in this bibliography, with the idea of making it more helpful to students and workers.

1. It is arranged alphabetically by authors and chronologically under the name of each author, taking always the senior author as guide in cases of more than one.

2. When it has been possible we have used the authors' full names which enabled us to verify the correctness of many of the citations and avoid confusion and errors in authorship.

3. Titles appear first in the original language with translation into English in parenthesis. In some cases it has not been possible to obtain the original paper and in those cases the translated titles appear in parenthesis. Some titles appear only in the original languages. In cases of slavic or oriental languages the titles are translated into English.

4. When an article appears in more than one publication all except the first appear in parenthesis.

5. We have not been able to see all the original papers on virus diseases of plants. Therefore, there are many which we have been unable to annotate.

The compilers do not claim that this bibliography is complete or without errors but if workers on virus diseases of plants will send their criticisms directly to the compilers, we will endeavor to publish

a supplement in which corrections and additions will be made. All correspondence and all papers should be addressed to the junior author.

In the preparation of the manuscript we are very much indebted to the kind and valuable assistance of Dr. John Hendle Barnhart, of the New York Botanical Garden, who made many corrections and gave many suggestions, to Hon. Carlos E. Chardon, Chancellor of the University of Puerto Rico, Hon. Rafael Menéndez Ramos, Commissioner of Agriculture and Commerce, Mr. Rafael Fernández García, Ex-Director of the Insular Experiment Station of Puerto Rico, Mr. Francisco A. López Domínguez, Director of Insular Experiment Station of Puerto Rico, for their advice and moral support in the preparation and publication of this manuscript.

Abbott, E[rnest] V[ictor], & Townsend, Charles H[enry] T[yler]

El mosaico de la caña de azúcar y su trasmisión. (Sugar cane mosaic and its transmission.) Perú Est. Expt. Agric. Soc. Nac. Agraria, Circ. **5**, 10 p., 1928.

Popular discussion of the subject.

————, & Wolcott, G[eorge] N[orton]

Mosaic of sugar cane in Perú. Science **69**(1788): 381, 1929.

Account of the occurrence of mosaic disease of sugar cane in Perú and of the abundance of *Aphis maidis* Fitch. its insect vectors.

Diseases of economic plants in Perú. Phytopathology **19**(7): 645–656, 1929.

Brief reference to mosaic of sugar cane.

A new host for sugar cane mosaic. Phytopathology (Abstract) **20**(1): 109, 1930.

Refers to our "caña india" known in Perú as "caña brava" (*Gynerium saggitatum*). Growing in or near cane fields becomes infested with mosaic.

Adam, D. B.

Degeneration of potatoes. Virus diseases and their control. Jour. Dept. Agric. Victoria **30**: 7–11, 1932.

Adams, J[ames] F[owler]

Lima bean and tomato mosaic. Delaware Agric. Expt. Sta. Circ. **14**, 29 p., 1924.

Adams, R[ichard] L[aban]

The California beet blight. Thesis submitted to the University of California for M. S. Degree, 1909.

Afzal Husain, M.

Leaf-curl in cotton. Nature **124**: 958, 1930.

Leaf-curl or crinkle in Sudan. Transmitted by an undetermined white fly (*Aleurodidæ*). *Empoasca devastans* is considered a cause of one form of leaf crinkle.

Agee, H[amilton] P[ope]

Sugar cane diseases in the Hawaiian Islands. Proc. H. S. P. A. **37**: 38–39, 42–43, 68–76, 77–78, 1917.

Sugar cane diseases. Proc. H. S. P. A. **39**: 153–156, 1919.

Sugar cane diseases. H. S. P. A. Expt. Stat. Ann. Rpt. **1920**: 18–21, 1920.

Resistance to diseases and adverse conditions by hardy sugar cane types. Louisiana Planter **72**(2): 75–76, 1924. (Australian Sugar Journ. **16**: 49–53, 1924.)

Report of the Committee in charge of the Experiment Station of the Hawaiian Sugar Producers' Association for the year ending September 1931. Inter. Sugar Journ. **34**(399): 101–102, 1932.

Notes on several diseases of sugar cane among which it is stated that mosaic disease of sugar cane is still present, but declining. Its effects are unremitting and sometimes serious. Also states that the origin of chlorotic streak disease remains unsolved, though control methods are known.

Ahr, J[oseph], Mayr, Chr., & Worle

Erntelíohe, knollensarbe und Blattrollkrankheit Kartoffeln in bezielung zu boden und Düngung. (Crop yield, tuber color, and leaf-roll of potato in relation to soil fertilizer.) Fuhling's Landw. Zeitg. **64**(17–18): 425–452, 1915.

Ainsworth, G. C.

Mosaic disease of the tomato. Expt. & Res. Sta. Cheshunt Herts., 17th. Ann. Rpt. **1931**: 42–43, 1932.

Juice from striped tomato plants innoculated into healthy plants produced mild mosaic in a majority of the cases. Stripe was produced in less than 40 per cent.

Virus disease investigations (*a*) Spotted wilt of tomatoes. (*b*) Mosaic and "stripe" disease of tomatoes. Expt. & Res. Sta. Cheshunt Herts. Ann. Rpt. **18**: 39–45, 1933.

Account of observations made during 1932. Inoculation experiments and list of host plants and insect vectors. Some suggestions for control measures are given.

An investigtion of tomato virus diseases of the mosaic "stripe", streak group. Ann. Appl. Biol. **20**(3) : 421–428, 1933.

Tomato mosaic was studied, described and compared to other types of virus diseases and spotted wilt.

Alamo Ibarra, Roberto

El mosaico, matizado o rayas amarillas de la caña de azúcar. (Mosaic, mottling or yellow stripe disease of sugar cane.) Venezuela Min. de Fomento, Pamphlet, 55 p., 1927.

Popular discussion of mosaic of sugar cane under Venezuelan conditions.

Alben, A. O., Cole, J[ohn] R., & Lowis, R. D.

Chemical treatment of pecan rosette. Phytopathology **22**(12) : 595–601, 1932.

The authors were able to improve old rosetted leaves and bring young ones back to normal by dipping or spraying them with a solution of ferric sulphate or ferric chloride, ranging in strength from 0.6 to 1 per cent. These findings would seem to indicate that pecan rosette is a condition of iron chlorosis.

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New development in treating pecan rosette with chemicals. **22**(12) : 979–981, 1932.

A short paper giving the results of spraying trees with zinc and iron salts. These results indicate that zinc is an essential element for the healthy development of the trees.

Alexander, Jerome

Bacterial filters and filterable viruses. Science n.s. **65**(1678) : 207, 1927.

A very brief paper on bacterial filters and filterable viruses in general, in which the author discusses several types of filters. No reference to plant viruses.

Alfaro, Julio

A method of fighting the propagation of mosaic disease in sugar cane. Planter & Sugar Manuf. **75**(20) : 388–389, 1925. (Sugar **28**(1) : 45, 1925. Trop. Agric. (Ceylon) **66**(2) : 113–114, 1925. El Mundo Azucarero **13**(5) : 150, 1925. Proc. Agric. Soc. Trinidad & Tobago **25**(2) : 437–439, 1925.)

Recommends the use of resistant varieties.

Statement on mosaic control. Proc. Conf. Int. Soc. Sugar Cane Tech. (Havana) **2**: 9199, 1927.

Allard, H[arry] A[rdell]

The mosaic disease of tobacco. Science n.s. **36**(938): 875–876, 1912.

The author's first paper on this subject, in which he gives a brief statement of the results of inoculation experiments and some of the symptoms. It is not produced by cutting back and not carried in the pollen. Also calls attention to the presence of aphids and suggests that the disease is probably due to a living active microorganism.

The mosaic disease of tobacco. U.S.D.A. Bull. **40**, 33 p., 1914.

More extensive than the preceding. Gives special attention to cross inoculation experiments and to symptoms. Produced the disease by root inoculation and gives evidence that the disease is carried by *Macrosiphum tabaci* Perg.

A review of the mosaic disease of tobacco, together with a bibliography of the most important contributions. Bull. Torrey Bot. Club **41**(9): 435–458, 1914.

An excellent review of the literature to date.

Distribution of the virus of the mosaic disease in capsules, filaments, anthers and pistils of affected plants. Journ. Agric. Res. **5**(6): 251–256, 1915.

Demonstrated that the virus penetrated to all parts of the plant except the seeds.

Effect of dilution upon the ineffectivity of the virus of the mosaic disease of tobacco. Journ. Agric. Res. **3**(4): 295–299, 1915.

Gives effects of dilution of the virus. 1–1000 fully as effective as pure juice. 1–10,000 much less effective than pure juice. Believes the disease due to a parasite and not due to an enzyme.

Some properties of the virus of the mosaic disease of tobacco. Journ. Agric. Res. **6**(17): 649–674, 1916.

A very thorough study of the properties of the virus with reference to chemicals and temperature. Believes that the disease is due to an ultramicroscopic parasite.

The mosaic disease of tomatoes and petunias. Phytopathology **6**(4): 328–335, 1916.

Gives the results of experiments with the mosaic disease of tomatoes and petunias which is in harmony with preceding studies on the mosaic of tobacco.

A specific mosaic disease in *Nicotiana viscosa* distinct from mosaic of tobacco. Journ. Agric. Res. **7**(11): 481–486, 1916.

The author gives evidence indicating that mosaic of *N. viscosa* is different from the ordinary mosaic of *N. tabacum* and the tomato (*Lycopersicum esculentum.*)

Further studies of the mosaic disease of tobacco. Journ. Agric. Res. **10**(12) · 615–632, 1917.

The active agent does not penetrate readily when sprayed on plants but does penetrate very slight wounds. Easily removed from hands by washing. Killed in soil by steam sterilization. *Nicotiana glauca* is susceptible. Is carried by *Mysus persicae.*

Mosaic disease of *Phytolacca decandra*. Phytopathology **8**(1): 51–54, 1918.

Experimental evidence indicates that the mosaic of tobacco and *Phytolacca decandra* are different. The active agent overwinters in the plant.

Effects of various salts, acids, germicides, etc., upon the infectivity of the virus causing the mosaic disease of tobacco. Journ. Agric. Res. **13**(12): 619–637. 1918.

Gives the results of extensive experiments to determine the effects of many chemicals on the virus causing mosaic of tobacco.

Abnormalities in Nicotiana. Bot. Gaz. **65**(2): 175–185, 1918.

A description of abnormalities resulting from mosaic.

Some possible relationships of the mosaic diseases. Phytopathology **13**(12): 555–557, 1923.

A presentation of unsettled problems in connection with the study of the mosaic disease.

Allen, F[rank] W[isdom]

Maturity and rate of ripening of Gravenstein apples in relation to bitter pit development. Amer. Soc. Hort. Sci. Proc. **28**: 639–645, 1931.

Report of observations correlating maturity and bitter pit. Different treatments are reported.

Altson, R[alph] A[bbey]

Report on a suspected outbreak of infectious mosaic disease among certain canes in the colony. Journ. Bd. Agric. British Guiana. **18**(3): 216–225, 1925. (Int. Sugar Jour. **27**(318): 293, 1925.)

Mosaic is the most serious problems in Jamaica. Gives record of losses.

Amaral, Afranio de

Pompen do mosaico. Bol. Agric. (Sao Paulo) Brasil **27**: 147–156, 1926.

Amos, J., Hatton, R[oland] G[eorge], Knight, R[obert] C[edric], & Massee, A. M.

Experiments in the transmission of reversion of black currant. East Malling Res. Sta. Ann. Rpt. Suppl. **15**: 43–46, 126–150, 1927.

The disease was produced by transferring big-bud mites from diseased to healthy plants, by grafting and inarching.

Reversion of black currants. Its incidence and spread in the field in relation to possible control measures. Journ. Pomol. Hort. Sci. **6**(3): 167–183, 1927, (4): 282–295, 1928.

The vector appears to be the big-bud mite *Eriophyes ribis*.

Anderson

Die wirkung der Viruskrankheiten der Kartoffel. (The effect of virus diseases of potatoes.) Prakt. Blät. Pflanzenbau u. Pflanzen. Schutz. **3**: 132–136, 1925.

Anderson, F. G.

The phony peach disease in Illinois. Trans. Illinois State Hort. Soc. **66**: 214–217, 1933.

Popular description of the disease, warning to farmers to eradicate it. Has been known in Illinois since 1927.

Anderson, H[arry] W[arren]

Spinach mosaic. Illinois Acad. Sci. Trans. **15**: 130–140, 1922.

Control of bramble diseases. Kansas State Hort. Soc. Bienn. Rpt. **11**: 162–167, 1930.

Anderson, James

On the disease called the curl in potatoes, and some other particulars observed with regard to this plant. Bath Soc. paper 2d. ed. **4**: 92–107, 1792.

Annaud, P. M., Chamberlain, J. C., Henderson, C. F., & Waters, H. A.
Movement of the beet leaf hopper in 1930 in Southern Idaho. U.S.D.A. Circ. **244**, 24 p., 1932.

Although this paper is not on virus diseases, we included it, because of the great interest for the students on the subject, due to its close relationship.

Anonymous
Abridgment of several letters published by the Agricultural Society at Manchester in consequence of a premium offered for discovering the cause of the curled disease in potatoes. Letter No. V. Letters and Papers on agriculture, etc. Bath and West of England Society, Vol. **I**, 4th ed., p. 240–242; Letter IX p., 246; Letter XI, p. 248; Letter XV, p. 252; Letter XVI p., 252–253; Letter XVII, p. 254; Letter XVIII, P. 255, 1792.

Historical value only.

On the curl in potatoes, with a radical cure. Ann. of Agric. 31, 1798.

Historical value only.

Plan for preventing the curl in potatoes. Farmer's Mag. **3**: 13, 1802.

Historical value only.

Die blattrollkrankheit der Kartoffel. (The leaf roll disease of potato.) Zeitschr. Land. Versuchsw. Osterr. **14**(7): 911–915, 1911.

Gele strepenziekte. (Yellow stripe disease.) Meded. Arch. Java Suikerind. **20**: 1590–1593, 1912.

Plant disease in 1915. Phytopath. Lab. Willie Commelin Schotten 1915, p. 18, 1916.

Mosaic disease of cucumber. Market Growers Journ. **19**: 34, 1916. (Amer. Flor. **46**: 1164, 1916.)

Mosaic disease of tobacco and tomatoes. Gard. Chron. 3 ser. **59**(1526): 172–173, 1916.

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(Dwarf disease of barley.) Journ. Plant. Protec. **3**: 937–942, 1916.

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(Experiments for the control of the dwarf disease of potatoes.) Okayama Agric. Expt. Sta. Ann. Rpts. **1915**: 143–144, 1916; **1916**: 183–184, 1917.

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(On the stripe disease of the rice plant.) Imp. Agric. Expt. Sta. Ann. Rpt. **1913**: 15–41, 1917.

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Plant diseases in Ontario. Ontario Agric. Col. & Expt. Farm **43**: 20–31, 1917.

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New disease causes alarm. Facts About Sugar **6**: 426, 1918.

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Sugar cane leaf stripe disease. H.S.P.A. Proc. **39**: 196–202, 1919.

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Louisiana Planter **63**: 82, 1919.

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(Phytopathological review.) Agric. Colon. (Italy) **23**(9): 356–362, 1919.

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Report of the conference on sweet potato problems and on diseases of cotton, corn and tomatoes. Washington: Advisory Bd. Amer. Plant Path., Amer. Phytopath. Soc. 16 p., 1919.

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(Potato diseases.) Meded. Phytopath. Dienst (Wageningen) **6**: 19, 1919.

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Mosaic disease as a factor influencing yield. Potato Mag. **2** (5): 11, 27, 1919.

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The mosaic disease. Louisiana Planter **63**: 253–255, 1919.

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Porto Rico fights cane mottling disease. Sugar **22**: 208–210, 1920.

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Mosaic or mottling disease. Agric. News (Barbados) **19**: 245, 1920.

Mosaic disease in potatoes. Agric. Gaz. Canada **7**: 557–558, 1920.

The cause of the sugar cane mottled or mosaic disease. Louisiana Planter **65**: 195–196, 1920.

Potato leaf curl. Journ. Min. Agric. (London) **27**: 287–289, 1920.

Rajeunissement et perfectionnement de la pomme de terre. (Rejuvenescence and perfection of the potato.) Journ. Agric. Pract. Jan. 1, 1920.

La "filosité". Journ. Agric. Pract. April 1, 1920.

Florida Plant Board. Third Bienn. Rept. p. 67–71, 89–90, 1921.

Mosaic disease in Barbados. Agric. News (Barbados) **20**: 15, 1921.

Mosaic disease—susceptible and immune varieties. Journ. Jamaica Agric. Soc. **25**: 427–429, 1921.

Mosaic disease. Expt. & Res. Sta. Cheshunt Herst., Ann. Rpt. **7**: 41, 1921.

Mosaic disease of sugar cane and control measures. Louisiana Planter **66**(12); 186–187, 1921.

Yellow stripe disease investigations (Progress report). Int. Sugar Journ. **23**: 453–454, 1921.

(Varietal susceptibility of the potato to the curly dwarf.) Hokkaido Agric. Expt. Sta. Ann. Rpts. **1915**: 20, 1916; **1916**: 20, 1917; **1919**: 65–66, 1921.

The mosaic disease of sugar cane in Trinidad. Int. Sugar Journ. **23**: 74–75, 1921.

Fiji disease controlled by seed selection. Sugar Cent. & Planters' News. **2**(8): 335–336, 1921.

The Fiji "disease" of sugar cane. Journ. Dept. Agric. Union South Africa. **2**: 554–556, 1921.

Mosaic disease of sugar cane. Florida Plant Bd. Bienn. Rpt. 1919–20, **3**: 67–71, 89–96, 1921.

Notes on the Government action to prevent the spread of the disease and data of losses.

Mosaic disease of sugar cane. Louisiana Planter **69**(25): 442–443, 1922.

Review of Kunkel and Lyon's work. Conclusions, given control measures.

Plant diseases: Three major cane diseases. Agric. News (Barbados) **21**: 62, 1922.

Sugar cane mosaic infested areas. Florida State Plant Bd. Circ. **44**, 2p, 1922.

Transmission of sugar cane mosaic by aphids. West Indian Committee, Circ. **37**: 521, 1922.

Leaf curl and mosaic disease of potato and their relation to deterioration in yield. Fruit Grower & Veg. Trade Journ. (London) **41**(19): 529–530, 1922.

Louisiana Planter **69**(25): 442–443, 1922.

Report of the Department of Agriculture, Barbados, for the financial year 1921–22, p., 19. (Rev. Appl. Mycol. **2**: 260–261, 1922.)

Mosaic disease of potatoes. Kentucky Agric. Expt. Sta. Ann. Rpt. **1921**: 45, 1922.

Bunchy top in bananas. Queensland Agric. Journ. **18**(5): 307, 368–369, 1922.

The author discusses a treatment with sulphur and lime.

Mosaic disease of sugar cane. Louisiana Planter **69**: 442–443, 1922.

A popular paper with special attention to Kunkel's work in Hawaii.

Banana bunchy top disease. Queensland Agric. Journ. **19(1)**: 32–33, 1923.

A discussion of cause and control. Apparently written before the cause was known.

Degeneration of the potato. Gard. Chron. **73**: 25–26, 1923.

Effect of selection of "seed" on the yield of the potato crop. (Leaf roll disease) Journ. Dept. Agric. Ireland **22**: 378–380, 1923.

Leaf-roll and mosaic, two important diseases of the potato. Ireland Dept. Agric. & Tech. Instr. Spec. Leaflet **24**, 4 p., 1923.

Mosaic disease in potatoes. Kentucky Agric. Expt. Sta. Ann. Rpt. **1922**: 37–38, 1923.

Mosaic disease. Gard. Chron. **73**: 345, 1923.

New peanut disease (rosette). Journ. Dept. Agric. South Africa **7**: 191, 1923.

A record.

The study in degeneracy in potatoes. Nebraska Agric. Expt. Sta. Ann. Rpt. **1922**: 10–11, 1923.

Virus diseases in plants. Gard. Chron. **74**: 168, 1923.

Virus diseases of plants. Nature **111**: 551, 1923.

Sugar and mosaic disease of canes. Journ. Jamaica Agric. Soc. **27**: 864–869, 1923.

A popular review of the subject.

Treatment of mosaic in Natal. Strong views of the Government Entomologist. South African Sugar Journ. **7**: 745–747, 1923.

Mosaic disease in Jamaica. West Indian Committee Circ. **38** (653): 435–436, 1923.

Verslag over het jaar 1922 Departement van Landbouw in Suriname. (Report of the Department of Agriculture, Suriname, for the year 1922,) p. 106, 1923.

Press cake and mosaic. Sugar Cent. & Plant. News **4**: 84, 1923. (Int. Sugar Journ. **25**: 315, 1923.)

A mosaic immune cane. Sugar Cent. & Plant. News **4**: 83, 84, 1923. (Int. Sugar Journ. **25**: 322, 1923.)

Mosaic disease. Agric. Journ. India **19**: 198–201, 1923.

Louisiana Planter **70**(6): 103, 1923.

El Mundo Azucarero **10**(6): 162–163, 1923. La enfermedad moteada de la caña. (The mottle disease of sugar cane.)

Mosaic disease. Gard. Chron. **73**: 345, 1923.

On insect transmission of mosaic, especially in Java. Int. Sugar Journ. **25**: 346–351, 1923.

Virus diseases of plants. Nature **112**: 293, 1923.

The mosaic disease of sugar cane order 1923. Journ. Jamaica Agric. Soc. **28**: 27, 1924.

Jahresbericht der Preussischen Landwirtschaftlichen Versuchs und Forschungsanstalten zu Landsberg-an-Warthe Jahrgang 1923–24. (Annual Report of the Prussian Agricultural Experiment and Research Station at Landsberg-an-der-Warthe, 1923–24.) Landw. Jahb. **60**: 127–260, 1924.

Plant diseases, South Africa. Journ. Union So. Africa Dept. Agric. **8**(1) 9, 1924.

Tobacco mosaic. Mauritius Dept. Agric. Ann. Rpt. **1923**: 10–11, 1924.

Mosaic disease eradication campaign. South African Sugar Journ. **8**(7): 523–524, 1924.

The Uba cane controversy. Australian Sugar Journ. **16**: 392, 1924.

Precautions against diseases. Australian Sugar Journ. **16**: 504–505, 1924.

El Dr. Cross y el mosaico de la caña en Cuba. (Dr. Cross and mosaic disease of sugar cane in Cuba.) Rev. Agric. Com. & Trab. Cuba **7**(3): 10–11, 1924.

Controversial.

Mosaic resistant varieties of cane to be grown by Louisiana planters in Florida. Louisiana Planter **72**: 359, 1924.

Natal Acts to stop mosaic. Facts About Sugar **19**: 450, 1924.

Experimental Agriculture in Jamaica. Int. Sugar Journ. **26**: 274–276, 1924.

Cane seedling work in Hawaii. Australian Sugar Journ. **16**: 163–164, 1924.

From all sources. So. African Sugar Journ. **8**: 461, 1924.

The Natal Planters' Union. Annual General Meeting. So. African Sugar Journ. **8**: 256–257, 259, 261, 263, 267, 1924.

Mosaic disease in Natal. Important communications from world's experts. South African Sugar Journ. **7**(4): 269–271, 1924.

Verslag over het jaar 1923. Dept. van Landbouw in Suriname, 114 p., 1924.

This report contains information about the sieve tubes (Phloem-necrosis) of coffee trees and probable insect carriers.

Work in connection with insect and fungus pests and their control. Antigua Dept. Agric. Rpt. **1922–23**: 7–8, 1924. (Rev. Appl. Mycol. **4**: 59–60, 1925.)

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Sprain or internal brown spot of potatoes. Phytopathology 16(10): 711–722, 1926

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Experiences de rejeunissement et de perfectionnement de la pomme de terre. (Experiences on the rejuvenation and improvement of the potato.) Rev. Gén. Bot. **33**: 183–189, 244–263, 1921.

Averna-Saccá, Rosario

Algunas das moestias cryptogamicas do tabaco *Nicotiana tabacum.* (Some of the cryptogamic diseases of tobacco *Nicotiana tabacum.*) Bol. de Agric. Sao Paulo. Brasil, **23**(7–8): 201–268, 1922.

Sobre a presença de um protozoario nos tecidos da canna de assucar atacadas pelo "mosaico". (On the presence of a protozoa in tissue of cane attacked by mosaic.) Bol. de Agric. Sao Paulo, Brasil, **27**(8–9): 183–204, 252–273, 303–319, 388–398, 1926; **28**: 173–182, 1927.)

A histological study in which the author describes a protozoan living in diseased plants. The author believes this organism to be the causal agent.

Badami, B. S. R., & Iyengar, C. S. R.

The bio-chemistry of the spike disease of sandal (*Santalum album* Linn.) I. Note on the influence of chlorine on starch accumulation in disease. II. The role of manganese in health and disease. Mysore Sandal Spike Invest. Committee. Bull. **2**, 12 p., 1932.

Report of studies on the composition of healthy and spike diseased sandal (Santalum Album L.) leaves. A low chloride concentration co exist with an excess of starch and a relatively increased diastatic activity in diseased leaves. In regard to manganese the authors declare that spike disease is not due to a lack of it.

Bailey, Irving W[idmer]

Slime bodies of *Robina pseudo-acacia.* Phytopathology **13**(7): 332–333, 1923.

Micro preparations of the phloem of tissue of *Robina pseudo-acacia* showed slime bodies described by Strasburger. They are similar to the bodies described by Nelson as associated with mosaic.

Bailey, L[iberty] H[yde]

Some troubles of winter tomatoes. Cornell Univ. Agric. Expt. Sta. Bull **43**: 149–158, 1892.

A description of winter blight of tomatoes which is now recognized as a virus disease.

Peach yellows. Cornell Univ. Agric. Expt. Sta. Bull. **25**, 1890. Bull. **75**: 383–403, 1894.

Gives a description and a discussion.

Baissac, Louis

La cane a sucre est encore indemne de mosaïque á Maurice. (Sugar cane still unaffected by mosaic in Mauritius.) Rev. Agric. L'Ile Maurice (43) : 7–10, 1929.

Bakke, A[rthur] L[awrence]

The comparative rate of desiccation of tubers from normal and diseased potato plants. Phytopathology **9**(12) : 541–546, 1919.

This paper is a record of physiological studies which the author summarizes as follows:

(1) Curly-dwarf potato tubers on being desiccated reach equilibrium with evaporating power of the air before normal potatoes of the same variety.

(2) The diseased tubers contain more suberin at the start, but later fissures are developed which cause the curly-dwarf tubers to reach their equilibrium earlier.

(3) Curly-dwarf potatoes which are completely dried, on being placed in water show a greater absorption than desiccated normal tubers similarly placed.

Bald, J[ames] G[rieve,] & Samuel, G[eoffrey]

Investigations on the spotted wilt of tomatoes II. Australian Council for Sci. & Indus. Res. Bull. **54**, 24 p., 1931.

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Some factors affecting the inactivation rate of the virus of tomato spotted wilt. Ann. Appl. Biol. **21**(2) : 179–190, 1934.

The authors state that the inoculum of tomato wilt when stirred in the process of inoculation lost its virulence more rapidly than when left undisturbed and that the rate of inactivation was increased by bubbling air through it. The exclusion of free nitrogen in the bubbling air process practically does not interfere with the rate of inactivation. The authors give the results of six reducing agents tested, (sodium sulphite, sodium nitrite, ferrous sulphate, tannic acid, hydroquinone acid, cysteine hydrochloride), and discuss them.

Ball, E[lmer] D[arwin]

The leafhopper of the sugar-beet and their relation to the curly-leaf conditions. U.S.D.A. Br. Ent. Bull. **66** : 32–52, 1910.

The beet leafhopper and the curly-leaf disease that it transmits. Utah Agric. Expt. Sta. Bull. **155**, 56 p., 1917.

A review of the literature on the curly-leaf and the beet leaf-hopper. Gives the symptoms and distribution and expresses the opinion that the insects are the cause of the disease.

Barber, C[harles] A[lfred]

Report on spike disease in Coorg. Indian For. **29** : 21–31, 1903.

The mosaic or mottling disease of sugar cane. The main facts of the case to date. Int. Sugar Journ. **23**(265): 12–19, 1921.

A review of the studies on sugar cane mosaic by Johnson, Grey, Edgerton, Earle, Fawcett, Stevenson and Brandes.

On insect transmission of mosaic, especially in Java. Int. Sugar Journ. **25**(295): 346–351, 1923.

Review of Dr. G. Wilbrink's paper in Meded. Proefst. Java Suikerind. 10, 1922.

La situación actual en relación con el matizado en Cuba. (The present position as regards mosaic in Cuba.) Rev. Agric. Puerto Rico **13**(4): 265–272, 1924. (Int. Sugar Journ. **26** (309): 469–473, 1924.)

An account of the present status of the literature on the subject with a discussion on the disease.

The influence of mosaic on yield in Louisiana. Int. Sugar Journ. **26**(311): 581–582, 1924.

Review of Brandes's paper in Facts About Sugar 18(26): 610–611, 1924.

Experimental Agriculture in Jamaica. The campaign against mosaic. Int. Sugar Journ. **26**(309): 474–476, 1924.

Account of the position of sugar cane industry in Jamaica in regard to sugar cane mosaic disease and campaign to eradicate it.

Streak disease of Uba cane in Natal. Int. Sugar Journ. **27** (321): 472–479, 1925.

Review of Mr. Storey's paper on the subject in Rpt. Proc. Imp. Bot. Congr. p. 132–144, 1924. The author gives a review of our knowledge of this disease, including history, symptoms, range of effects (susceptibility in varieties and wild grasses), and transmission.

The Coimbatore cane seedlings in Bihar. Int. Sugar Journ. **28** (326): 75–77, 1926.

The Havana Conference on cane diseases. Inter. Sugar Journ. **30**(359): 575–582, 1928.

A record of the discussion on diseases of sugar cane. The greater part of the discussion was devoted to mosaic disease of sugar cane.

Baribeau, [Charles Henri] B[ernard]

La mosaïque de la pomme de terre. (The mosaic of the potato.) Scie. Agric. **1**: 181–183, 1921.

Barker, H[enry] D., & Neal, D. C.

Plant diseases in Mississippi during 1923. Quart. Bull. State Plant Board Mississippi. **3**(1): 13–33, 1924.

Popular notes on sugar cane, potato and sweet potato mosaic.

Plant diseases and pests in Haiti. Int. Rev. Sci. & Pract. Agric. n. s. **4**(1): 184–187, 1926. (Rev. Appl. Mycol. **5**(9): 583, 1926.)

Barreto, B[raulio] T.

Algo sobre la extirpación del matizado. (Facts on mosaic eradication.) Rev. Agric. Com. & Trab. Cuba **7**(4): 12–13, 1924. (Agricultura **2**: 8–9, 1924.)

La situación de la enfermedad "Mosaico" en la Provincia de Camagüey. (Mosaic disease situation in the Province of Camagüey.) Agricultura **1**: 150–152, 1925.)

Barrus, M[ortimer] F[ranklin]

Physiological diseases of potatoes. Quebec Soc. Prot. Plants 9th Ann. Rpt. **1916-17**: 45–53, 1917.

Potato mosaic and certified seed. Potato Mag. **4**: 13–14, 1918.

Popular

————, & Chupp, Charles D[avid]

Yellow dwarf of potatoes. Phytopathology **12**(3): 123–132, 1922. (Abstract.) **12**(1): 39, 1922.

A description of the disease which is new.

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Potato diseases and their control. New York State Agric. Coll. Ext. Bull. **135**, 123 p., 1926.

A popular publication giving good descriptions.

Barss, H[oward] P[hillips]

International potato disease conference. Potato Mag. **2**(2): 5–6, 27–30, 1919.

Brief discussion, chiefly on leaf roll, mosaic and spindling sprout diseases.

Bean blight and bean mosaic. Oregon Agic. Expt. Sta. Rpt. Dept. Bot. & Plant Path., Crops Pest & Hort. Rpt. **3**: 192–196, 1920.

Notes on bean mosaic. Recommendations, for the control of the disease.

Bean mosaic. Oregon Agric. Expt. Sta. Crop Pest & Hort. Rpt. **3** (1915–1920): 195–196, 1921.

Brief notes on the occurrence of this disease in Oregon. The author states that the disease is produced (mosaic) by the presence of some organism so minute that it cannot be detected by the highest powers of the microscope. Some control measures are given.

Barton-Wright, Eustace, & Mc Bain, Alan

Studies in the physiology of the virus diseases of the potato: A comparison of the carbohydrate metabolism of normal with that of leaf roll potatoes. Trans. Roy. Soc. Edin. **57** (11): 309–349, 1932.

A very detailed account of the authors' experiments and observation, under control conditions, about the formation of and the nature of translocatory sugars in healthy and leaf roll potatoes. The disease was transmitted by means of *Myzus persicae* successfully in all cases.

Recent advances in botany. Chapter 9. Virus diseases of plants. Philadelphia 1922. (Phytopathology **22** (11): 929-932. 1932.)

----------, & Mc Bain, Alan

Possible chemical nature of tobacco mosaic virus. Nature **132** (3348): 1003–1004, 1933.

In this short paper the authors report their observations while studying Johnson's No. 1 tobacco mosaic. They describe the several reactions obtained and as conclusions, they found a white crystalline compound containing no nitrogen and yet highly infectious which is considered by the writers to preclude the "living entity" theory of the tobacco mosaic virus. In its precipitation with safranin it shows affinities with the proteolytic enzymes.

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Studies in the physiology of the virus diseases of the potato. II. A comparison of the carbohydrate metabolism of normal with that of crinkle potatoes; together with some observations on carbohydrate metabolism in a "carrier" variety. Ann. Appl. Biol. **20** (4): 526–548, 1933.

Continuation of previous work. The present investigation was con-

cerned with the formation of carbohydrates in healthy and crinkle infested potato plants, and the nature of sugar or sugars in transport. A series of observations were also made to determine whether there were any differences in the carbohydrate metabolism when a latent virus (paracrinkle) was present in a variety.

Studies in the physiology of the virus diseases of the potato. III. A comparison of the nitrogen metabolism of normal with that of leaf-roll potatoes. Ann. Appl. Biol. **20**(4): 549–589, 1933.

Continuation of previous work. The present investigations is concerned with the differences between the nitrogen metabolism of healthy and leaf roll affected potato plants.

Baudys, E[duard]

Hospodarska Fytopathologie. Dil 1. Prednasky o chorobach hospodarskych rostlin. (Agricultural phytopathology. Part 1. Lectures on diseases of agricultural plants.) Brno. Rolnicka Tiskarna (Agricultural Press) 327 p., 1929.

Second part on virus diseases.

Fytopathologicke poznamky V. (Phytopathological notes V.) Ochrana Rostlin **9**(5–6): 108–128, 1929. (With German summary.)

Phytopathologické poznamky VII. Ochrana Rostlin **11**(6): 178–197, 1931.

Studies on virus diseases of the following crops: soybean, plum, apricot and peach.

Baur, E[rwin]

Zur Aetiologie der Infektiose Panachierung. (About the etiology of infectious variegation.) Ber. Deutsch. Bot. Ges. **22** (8): 453–460, 1904.

Ueber die infektiose chlorose der malvaceen. (About the infectious chlorosis of Malvaceae.) Sitzungsb. Klg. Preuss. Akad. d. Wissensch. Bd. **1**, p. 11–29, 1906.

The infectious chlorosis of the Abutilon is latent and develops under favorable conditions. Transmitted by grafting.

Weitere Mitteilungen über die infectiöse Chlorose der Malvaceen und über einige analogen Erscheinungen bei *Ligustrum* und *Laburnum*. (Further information on infectious chlorosis

of Malvaceae and on several similar chlorosis appearing on *Ligustrum* and *Laburnum.*) Ber. Deutsch. Bot. Ges. **24**: 416–428. 1906.

Über infectiose Chlorosen bei *Ligustrum, Laburnum, Fraxinus, Sorbus,* und *Ptelea.* (About infectious chlorosis on *Ligustrum, Laburnum, Fraxinus, Sorbus, Ptelea.*) Ber. Deutsch. Bot. Ges. **25** (7): 410–413, 1907.

The variegations on many plants is due to infections chlorosis as proved by grafting.

Bemerkungen zur der arbeit: H. Lindermuth, Studien über die sogennannte panaschure und über einige begleitende erscheinungen. (Observations on the work: H. Lindermuth, Studies on the so-called variegations and some accompanying phenomena.) Land. Jahrb. Bd. **37** (5): 895–897, 1908.

Ueber eine infecktiose Chlorose von *Euonymous japonicus.* (On an infectious chlorosis on *Euonymous japonicus.*) Ber. Deutsch. Bot. Ges. **26** (18): 711–713, 1908.

Chlorosis of *Euonymous japonicus argenteo-marginatus* is not infections but that of *E. japonicus aureo-margi.. tus* is infectious.

Das wesen und die Erblichkeits-verhaltnisse der "Varietates *albo morginatae* hort. von *Pelargonium Zonale.* (On the nature and hereditary conditions of the horticultural variety *albo marginatae* of the *Pelargonium Zonale.* Zeitschr. Ind. Abst. Vererb. **1**: 330–351, 1909.

Zur aetiologie der infektiosen panaschierung. (On the etiology of infectious variegations.) Bot. Ges. **22**: 453–460, 1904.

Bawden, F. C.

A study on the histological changes resulting from certain virus infections of the potato. Proc. Roy. Soc. London, ser. B. **109**: 74–85, 1932.

The author describes three types of necrosis—(1) acronecrosis, (2) acropetal necrosis and (3) leaf roll necrosis which is Quanjer's phloem necrosis.

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Infra-red photography and plant virus diseases. **Nature 132** *(3326): 168, 1933.*

The author describes the results of his experiments and observations in infra-red photography of virus diseased plants.

Bayon, H. P.

Virus diseases of bacteria, plants and vertebrates. Journ. Trop. Med. & Hyg. **29**(2): 17–37, 1926.

Beale, Helen Purdy see Purdy, Helen Alice p. 297.

Beaumont, A[lbert,] & Hodson, W[illiam] E[dgard] H[umphreys]

Sixth Annual Report of the Seale-Hayme Agricultural College, Newton Abbott, Devon, for the year ending September 30, 1929.

Virus diseases of potatoes are discussed.

Beauverie, J[ean Jules]

La Maladie de la pomme de terre: "Enroulement et mosaïque." (The potato disease: Curl and mosaic.) Rev. Gén. Sci. **32** (**6**): 175–182, 1921.

Quelques aspects de la dégénérescence des plantes, applications au parasitisme. (Some aspects of plant degeneration, applications to parasitism.) Rev. Gén. Bot. **40**: 206–225, 264–276, 1928.

Beauverie, Marie-Antoinette

Les maladies a virus d'apres les travaux recents. (Recent work on virus diseases.) Rev. Bot. Appl. & Agric. Colon. **8**(80–81): 1–12, 334–339, (82): 404–410, 1928.

A review of work.

Les maladies á ultravirus des plantes. (The ultraviruses diseases of plants.) Ann. ser. Bot. & Agron. Tunisie **9**(1–2): 1–173, 1932.

A very comprehensive discussion of the subject subdivided into nine aspects. It is followed by a bibliography of 762 titles.

Bechhold, H., & Schlesinger, M.

Grösse von virus der mosaikkraukheit der Tabakpflanze. Phytopath. Zeitschr. **6**(6): 626–631, 1933.

Beckwith, C[harles] S[teward,] & Hutton, S[idney] B.

Cranberry false blossom and the blunt-nosed leafhopper. New Jersey Agric. Expt. Sta. Bull. **491**, 16 p., 1929.

This disease has been known in New Jersey since 1915 and has become abundant since 1920. The authors give a description of the diseased plant, the life history of the insect and methods of control.

Cranberry false blossom. New Jersey Agric. Expt. Sta. Circ. **275**, 4 p., 1933.

Popular information about cranberry false blosson in New Jersey, which is becoming a very serious disease in the State. The author formulates, as means of control, the flooding and spraying of the bogs to eliminate the insect carrier, the blunt nosed leathopper (*Euscelis striatulus*).

Bedson, S. P., & Bland, J. O. W.

A simple method for determining the electrical charge carried by virus particle. Brit Journ. Expt. Path. **10**: 67, 1929.

Behrenz, J[ohannes]

Weitere Beiträge zur Kenntnis der Tabakspflanze. Landwirstch. Versuch. **52**: 214–432, 1896. (Justs Bot. Jahresb. (Rev.) **28**: 1900. Zeitscher. f. Pflanzenkh. **10**: 192–193, 1900.)

Beijerinck, M[artinus] W[illem]

Ueber ein Contagium vivum fluidum als Ursache der Fleckenkrankheit der Tabaksblatter. (About the "Contagium vivum fluidum" as the cause of leaf-spot disease of tobacco leaf.) Verhandel K. Akad. Wetensch. Amsterdam, Sect. 2, deel **6**, (5): 1–22, 1898. (Centr. Bact. II Abt. **5**: 27–33, 1899.)

Over een contagium vivum fluidum als oorzaak van de Veeckziek te der Tabakblanden. (About the "Contagium vivum fluidum" as the cause of leaf-spot disease of tobacco.) Verlag Koninkl. Akad. van Wetensch. te Amsterdam, Wis. en Natuurk Afd. van Zaterdag **7**(6): 229–235, 1898.

Bernerkung zu dem Anfsatz von Herr Iwanowski Tabaksplanze. Cent. f. Bkt. **25**: 310–311, 1899.

De l'existence d' un contagieux vivant fluide agent de la Nielle des feulles de Tabac. (About the "Contagium vivum fluidum" as the cause of leaf-spot disease of tobacco.) Achiv. Neerland des Sc. Extractes et Nat. ser. **3**: 164–186, 1899.

Uber ein Kontagium vivum fluidum als Ursache Flekenkrankheit der Tabaks-blätter. (About the "Contagium vivum fluidum" as the cause of leaf-spot disease of tobacco.) **Centr. Bakt.** Abt. II, **27–33**, 1899.

Beke, L[adislaus] von

Beiträge einer Blattrollkrankheit der Kartoffelpflanze. (Contribution to leaf roll disease of the potato.) Jahresb. Ver. Angew. Bot. **10**: 145–155, 1912.

Bell, A[rthur] F[rank]

Cane diseases in Louisiana and West Indies. Australian Sugar Journ. **18**(10): 601–607, 1927. (Louisiana Planter (Abstract) **78**(8): 147–148, 1927.)

Report of the sugar pathologist. Queensland Bur. Sugar Expt. Sta. Ann. Rpt. **28**: 10–13, 1928.

A brief note on inspection for Fiji and mosaic of sugar cane.

The distribution of sugar cane mosaic. Ref. Book Sugar Industry of the World **7**: 31–32, 1929.

Report of the results of the observations made by the author during 1924–1928, while visiting the most important sugar cane producing centers. Concludes by inserting a list of the seven major diseases of sugar cane with their geographical distribution.

Work of the Division of Pathology. Queensland Br. Sugar Expt. Sta. Ann. Rpt. **30**: 36–41, 1930.

The author states that Fiji disease is prevalent in the Bunderberg area. Gives some Coimbatore canes as susceptible to mosaic.

The Fiji disease menace in Southern Queensland. Queensland Agric. Journ. **38**(5): 417–420, 1932.

A brief history, description of symptoms and method for control.

Dwarf disease of sugar-cane. Queensland Br. Sugar Expt. Sta. Div. Path. Bull. **3**: 3–12, 1932. (Farmers' Bull. **8**, 8 p., 1933.)

A very complete description of this new virus disease.

Benecke, F.

Proefhemingen ter bestrijding der "sereh". Semarang. 27 p., 1890.

Is het mogetijk uit typische "sereh" stekkengezond suikerriet te telen? Meded Proefstat Midden-Java te Semarang 10 p. 1890.

De bestrijding der onder der naam "sereh" saamgevatte ziekteverschijnselen van het Suikerriet. Semarang 16 p. 6 Sept. 1891.

"Sereh". Onderzoekingen en beschouwingen over oorzaken en middelen. Meded. Proefstat. Midden-Java **6**: 61–94, 1893.

Bennett, C[arlyle] W[ilson]

Disease control in black raspberries. Michigan Agric. Expt. Sta. Quart. Bull. **6**: 12–14, 1923.

Popular.

Peach yellows and little peach situation in Michigan. Michigan State Hort. Soc. Ann. Rpt. **56**: 187–196, 1926.

Popular.

Virus diseases of raspberries. Michigan Agric. Expt. Sta. Tech. Bull. **80**, 38 p., 1927.

The author discusses the history, economic importance and gives symptoms of the diseases. Also the results of extensive experimental work on dissemination which is by *Amphorophora rubi* and *Aphis rubiphila.*

Some raspberry mosaic symptoms. Phytopathology (Abstract) **19**(1): 89, 1929.

Further observations and experiments on the curl disease of raspberries. Phytopathology **20**(10): 787–802, 1930.

From experiments the author concludes that there are two viruses (Alpha and beta) responsible, according to variety, for curl disease of raspberries.

Further observations and experiments with mosaic disease of raspberries, blackberries and dewberries. Michigan Agric Expt. Sta. Bot. Sect. Tech. Bull. **125**, 1932.

Description of the general types of bramble mosaic. Consideration about insect vectors and their behaviour.

Berg. A. J. J.

Over den invloed eener warmwaterbenbandeling op de kieming van reetstekken. Arch. Suikrind. Nederl. Indië. **34**(3): 82-89, 1926.

Bergman, H. F., & Truran, W. E.

An apparent case of transmission of cranberry false blossom through a natural graft. Phytopathology **23**(8): 670–672, 1933.

The author describes a case of apparent transmission of cranberry false blossom through a natural graft which up to this date was practicable only with the aid of the leafhopper *Ophiola striatula*.

Berkeley, G[arven] H[ugh]

Report of the Dominion Field Laboratory of Plant Pathology, St. Catherine, Ontario. Dept. Agric. Expt. Farms, Div. Ann. Rpt. **1923**: 16–20, 1923.

A report on the virus diseases of raspberries.

------------, **& Jackson, A[ngus] B.**

Raspberry diseases. Phytopathology (Abstract) **14**: 347, 1924.

Studies in raspberry diseases, mosaic, leafcurl, rosette and wilt. Canada Dept. Agric. Pamphlet n.s. **72**, 15 p., 1926.

Report of the Dominion Field Laboratory of Plant Pathology, St. Catherine, Ontario. Dept. Agric. Expt. Farms, Div. Bot. Ann. Rpt. **1926**: 59–102, 124–130, 1927.

Tomato diseases. Canada Dept. Agric. Div. Bot. Bull. **15**, 1927.

Studies on tomato streak. Sci. Agric. (Canada) **7**(6): 210 223, 1927.

Strawberry mosaic. Canada Dom. Bot. Rpt. **1927**: 128–130. 1928.

Streak disease of the tomato. Ontario Dept. Agric. Ann. Rpt. Veg. Growers' Assoc. **25**: 52–59, 1930.

Diseases of the raspberry. Canada Dept. Agric. Pamphlet n s. **120**, 23 p., 1930.

A popular discussion (Rev. of Pamphlet N. S. No. 72) summarizing recent information regarding mosaic, leaf curl, rosette or bramble streak in Canada.

Tomato streak: transmission of the disease by seed. Canada Rpt. Dom. Botanist, St. Catherine, Ontario, Ann. Rpt. **1930:** 128, 1931.

Suspected strawberry mosaic. Canada Dept. Agric. Div. Bot. Rpt. Dom Botanist **1930:** 125 126, 1931.

This disease has the appearance of being due to virus but there is no absolute proof.

————————, & **Madden, G. O.**

Transmission of streak and mosaic diseases of tomato through seed. Sci. Agric. (Canada) **13**(3): 194–197, 1932; **13**(7): 455 457, 1933.

The authors give evidence that these diseases can be transmitted through the seeds. They also demonstrated that the viruses of both diseases existed in the seeds.

Bersch, W[ilhem J. K]

(The leaf roll disease of the potato in moor lands.) Zeitsch. f. Moorkultur u. Torfverwert., **8**(2): 90-96, 1910.

Besaude, Matilde

Flagellates in plants. A review of foreign literature. Phytopathology **15**(5): 273 281, 1925.

This paper does not discuss virus disease, but is of interest because of the protozoan theory of virus diseases.

A degenerescencia das batatas. (The degeneration of potato.) Actualidades Biol. **4**: 61 p., 1931.

This is a discussion of the properties of the viruses, cell inclusion, types of virus diseases, classification, losses, resistance and susceptibility and influence of environment.

Betancourt, P. E.

El mosaico en Cuba. (The mosaic in Cuba.) Rev. Agric. Com. & Trab. Cuba **7**: 23-25, 1925.

Bewley, W[illiam] F[leming]

Minute organisms isolated from the virus of mosaic disease of tomato. Nature **112**(2825): 903, 1923.

A preliminary paper giving the results of attempts to grow a virus in culture. Brittle bodies, resembling bacteria were found on the glass above the liquid.

Mosaic disease of tomato. Cheshut Expt. & Res. Station Ann. Rpt. **8**: 42, 1923.

Mosaic disease of cucumber. Expt. & Res. Sta. Cheshut Herts. 1925 Ann. Rpt. **11**: 86–89, 1926.

_________, **& Corbett, W[ilfred]**

Mosaic disease of tomato. Expt. & Res. Sta. Cheshut Herts. Ann. Rpt. **13**: 51–59, 1928.

Plant viruses. Nature **126**(3178): 471, 1930.

_________, **& Bolas, Bernard, J.**

Aucuba or yellow mosaic of the tomato plant: Reaction of infected juice. Nature **125**(3143): 130–131, 1930. (Rev. Appl. Mycol. **9**(7): 417, 1930.)

The results of experiments which indicate a destruction of chlorophyl.

_________, **& Corbett, W[ilfred]**

The control of cucumber and tomato mosaic disease in greenhouses by the use of clean seed. Ann. Appl. Biol. **17**(2): 260–266, 1930.

Mosaic disease of cucumber and tomato is decidedly transmissible. Roguing of diseased plants is a way to clean seed. The use of clean seed reduced the infection.

The nature of the virus principle in mosaic disease. Nature **127**(3203): 442, 1931.

Details of observations made by the author is given.

The nature of the virus principle in mosaic disease. Expt. & Res. Sta. Cheshut Herts. **17**: 45–46, 1932.

The author prepared juices from mosaic and healthy plants which were infected with culture of bacterial organism isolated from diseased stems. The infected juice became almost clear in 24 hours, which suggested bacteriophage type. No change occurred when aucuba mild mosaic and striped disease were used.

Bijl, P. A. van der

Agriculture in the winter rainfall area. The work of an important institution. (Ex Annual Rpt. Sec. of Agri. Year ending June 30, 1931). Farming in South Africa, **6**: 354–358, 1931.

Reports a virus disease on *Raphanus raphanistrum, Calendula officinalis, Tithonia diversifolia* and *Passiflora* sp.

Bijlert, A[lbertus] van

Opmerking, omtrent de verbreiding van een viekziekte, Meded. Slands Plantutuin. **43**: 49–52, 1899.

Observations about the spread of the diseases on the field.

Binkley, A[lmond] M.

Transmission studies with the new psyllid-yellows disease of Solanaceous plants. Science n.s. **70**(1825) : 615, 1929. (Rev. Appl. Mycol. **9**(5) : 332, 1930.)

Transmission of the disease by means of *Paratriozoa cockerelli* indicates that this disease is caused by a virus.

Transmission studies with the new psyllid-yellows disease of Solanaceous plants (a preliminary report). Proc. Amer. Hort. Sci. **1929**: 248–254, 1930.

The 1928 tomato variety work at the Agricultural Experiment Station was a complete failure because of this disease which is carried by *Paratriozoa cockerelli*. This insect also transmits the disease to *Capsicum annuum, Solanum Pseudocapsicum* and eggplant.

Biourge, [le Chanoine] P[h.]

La vaie cause de la degénérescence de la pomme de terre non pas Virus filtrant mais microbe (*Bac. ruber* N. et L.) (The true cause of the degeneracy of the potato is not a filterable virus but a microbe (*Bac. ruber* N. et L.) Agric., Louvain, 7 p., 1930.

————, **& Sokal, N.**

Nouvelles recherches sur les maladies de la pomme de terre dites á virus filtrants. (New investigation on the diseases of potatoes due to filterable viruses.) Agricultura **32**(2) : 77–114, 1932.

Birkeland, J[orgen] M.

Electrophoretic studies on purified plant viruses. Phytopathology (Abstract) **23**(1) : 4–5, 1933.

Experiments in acquired immunity in tobacco mosaic and spot necrosis. Phytopathology (Abstract) **23**(1) : 5, 1933.

Serological studies of plant viruses. Bot. Gaz., **95**(3): 419-436, 1934.

The author states:

1. That in addition to the antigenic constituents of healthy plant an antigenic element was found accompanying and inseparabl of the virus itself. Antibodies accompanying one virus i specific to it.
2. That viruses may be freed from the antigenic constituents o healthy plants, but not from the specific antigenic factors ac companying
3. That close association of the antigenic factor with infectivit and the specific nature of the antigenic fractions the differen viruses strongly suggest that this specific antigenic factor i either the virus itself or a virus plant protection complex n which the virus plays the role of haptene. Precipiting tes should prove to be a valuable aid in the further classificatior of plant viruses

Birmingham, W. A.

Conditions resembling American peach rosette. Agric. Gaz. N S Wales **31**: 581-582, 1920.

Description and suggestions for control

Bisby, G[uy] R[ichard], & Olaas, G.

Potato diseases in Minnesota. Minnesota Agric. Expt. Stat. Bull **190**, 44 p., 1920

Includes brief popular notes on several virus diseases of the potato

Blackman, V[ernon] H[erbert]

Discussion on some similarities and dissimilarities between plant and animal diseases, with special reference to immunity and virus diseases. Brit Med Journ. **1922**(3225): 718–722, 1922.

Blake, Maurice A[din]

Peach yellow and little peach. New Jersey Agric. Expt. Sta. Bull. **226**, 26 p., 1910.

Extensive discussion of the symptoms of these two diseases and also a discussion of winter injury.

————, & Connors, C[harles] H[enry]

Peach yellow and little peach at Vineland. New Jersey Agric. Expt. Sta Rpt. **1916**: 72–74, 1917.

————, Cook, Melville T[hurston,] & Schwarze, C[arl] A[lois]

Studies on peach yellow and little peach. Phytopathology (Abstract) **7**(1): 76–77, 1917.

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Recent studies on peach yellows and little peach. New Jersey Agric. Expt. Sta. Bull. **356**, 62 p., 1921. (Phytopathology (Abstract) **11**: 140–142, 1921.)
Records of very thorough field studies of these diseases.

Prominent enemies of the peach. Amer. Fruit Growers **43**(2): 8, 21, 31–33, 1923.

Blakeslee, A[lbert] F[rancis], & Avery, B. T.
Mutations in the Jimson weeds. Journ. Heredity **10**: 111–120, 1919.

A graft-infectious disease of *Datura* resembling a vegetative mutation. Journ. of Genetics **11**(1): 17–36, 1921.

An apparent case of non-Mendelian inheritance in *Datura* due to a disease. Proc. Nat. Acad. Sci. **7**: 116–118, 1921.

Blanchard, E[mile] & Perret, Claude
La enroulement de pomme de terre. (Leaf roll of potato.) Compt. Ren. Acad. Agric France **3**(31): 894–895, 1917.

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La maladie de l'enroulement des pommes de terre. (Leaf-roll disease of potatoes.) France Ann. Serv. Epiphy. **6**: 320–326, 1918.

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Recherches relatives a la maladie de l'enroulement de la pomme de terre affectuées dans le departement de la Loire. (Experiments on leaf roll disease of potatoes in the Department of Loire.) France Ann. Serv. Epiphy. **5**: 242–252, 1918.
The authors reported in the article the susceptibilty of different varieties and stated the date of appearance of the disease in 1918 Informed also that the use of stable manure and nitrate of soda reduced the losses due to the disease. The causal agent is not found in the soil, nor in the surface of the tuber.

Sur l'enroulement des feuilles de la pomme de terre. (Leaf roll of potatoes.) Compt. Rend. Acad. Agric. France **5**(10): 356–358, 1919.
After several years of experiments the authors believe that nitrogen hunger is the chief symptom of the disease. Is considered a degenerative disease due to intensive asexual propagation. Good fertilizing may improve the growth.

La maladie de l'enroulement de la pomme de terre (Leaf roll disease of potato.) France Ann. Serv. Epiphy. **7**: 294–303, 1921.

The authors disagree with Quanjer and others. They believe the disease to be physiological.

Blaringhem, L[ous Florimond]

Mosaïque hereditaire chez le pois *Pisum sativum*. (Hereditary mosaic in peas *Pisum sativus*.) Compt. Rend. Acad. Sci. (Paris) **175**(26): 1432–1434, 1922.

Blattny, C[tibor Eugen Marie Karel]

Studie o mosaikovych chorobach rostlin kulturnich, hlavne Bramboru. (Studies of diseases of cultivated plants, chiefly of the potato, related to mosaic.) Zemedelisky Archir. **15**(9-10): 459–482, 1924. (With French summary **16**(1–2): 8.)

Account of mosaic of *Clerodendon fragrans*.

(Uncommon diseases and pests of potatoes in 1925.) Ochrana Rostlin **5**: 74–76, 1925.

(Preliminary report of the irradiation of potatoes affected with leaf roll with B and radium rays.) Ochrana Rostlin, Prag **6**(3): 48–53, 1926.

(Virus diseases of raspberries and blackberries.) Ochrana Rostlin, Prag. **7**(3–4): 62–70, 1927.

(International experiments in Holland and Czecho-Slovakia on the degeneration of potato seed in different regions due to virus diseases.) Zemedesky Archiv., Prag **19**: 327–330, 423-438, 1928.

O methodáck studies virusovych chorob u chmele. (Methods of studying the transmission of Hop virus diseases.) Ochrana Rostlin **8**(2–3): 51–56, 1928.

(The mosaic of the lily of the valley (*Convallaria majalis* L.) Ochrana Rostlin Prag **9**(1): 19–21, 1929.

Poznamky o virovych a pribuzuych choroback rostlin I. (Notes on virus and similar diseases of plants I.) Ochrana Rostlin **10**(4–5) : 130–138, 1930. (With German summary.)

Several virus diseases are briefly discussed.

Studio o kaderavosti Chmele. (Studies on the "Kaderavost" disease of Hop.) Recueil de Trav. des Inst. des Recherches Agron. de la Rep. Tchecoslovaque Prag. **46**, 44 p, 1930. (With German and French summaries.)

An extensive discussion al out "Kaderavost" disease of hop being in Czecho Slovakia for 45 years. It is regarded as a virus disease.

Pokus S pasazi vira bramboso. (Experiment on the passage of potato virus.) Ochrana Rostlin **10**(3) : 65–70, 1930.

The virus can be transmitted from the tuber of a potato so resistant that it does not show symptoms to a susceptible variety that does show symptoms.

Virové choroby. (Virus diseases.) Ochrana Rostlin **11**(3–4) : 138, 1931.

A report on the condition for the year.

Lze Zjistiti pritomost vira pusobiciho nekteré choroby Bramboru v jéjich prenasesi, msicich? (Can the viruses that cause certain potato diseases be detected in their aphid vectors?) Vestn. Kral. Ces. Spol. Nank. 7 p., 1931.

Only one difference between vectors from diseased and healthy plants was observed. In the majority of the former the aureola around the cell nucleus was dark, in the latter it was clear.

------------, & **Vukulov, V.**

Mosaic bei *Epiphyllum truncatum*. (Mosaic on *Epiphyllum truncatum*.) Gartenbauwissenchaft **6** : 425–432, 1932. (Zeitschr. Pflanzenkrank. (Abstract.) **43**(2) : 88–59, 1933.)

Description of a virus disease on the cactus *Epiphyllum truncatum*.

Blodgett, F[orest] M[ilo,] & Fernow, Karl [Hermann]

Testing seed potatoes for mosaic and leaf-roll. Phytopathology (Abstract) **11**(1) : 58–59, 1921.

The relation of time and temperature to the killing of potatoes and potato mosaic virus. Phytopathology (Abstract) **12**(1) : 40–41, 1922.

———————, **Fernow, Karl [Hermann,] & Perry, F[rank] R[ichard]**
Testing seed potatoes for mosaic and leaf-roll. Phytopathology (Abstract) **12**(1): 40–41, 1922.

Time-temperature curves for killing potato tubers by heat treatments. Phytopathology **13**(11): 465–475, 1923.

The experiments reported in this work were conducted with particular reference to mosaic and leaf-roll diseases.

Hot water and hot air treatments of potatoes. Phytopathology (Abstract) **13**(1): 55, 1923.

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Tobacco mosaic on potatoes Phytopathology **17**(10): 727–735, 1927.

The author gives the results of cross inoculation experiments. The results agree with those obtained by Johnson and Fernow.

A potato virus on peppers. Phytopathology **17**(11): 775–782, 1927.

The author gives the results of inoculating peppers with potato virus. The resulting diseases appears to be the same as mosaic virus from potatoes used by Fernow on *Nicandra Physalodes* and *Nicotiana glutinosa.*

Blood, H[erbert] L[oran]
A "streak" of tomatoes produced by a disturbing principle from apparently healthy potatoes in combination with tomato mosaic virus. Phytopathology **18**(3): 311–312, 1928.

———————, **Richards, B[ert] L[orin], & Wann, F[rank] B[urkett]**
Studies of psyllid yellows of tomatoes. Phytopathology (Abstract) **23**(11): 930, 1933.

Boas, Friedrich
Die zuchterische Bekampfung der Blattrollkrankheit der Kartoffel. (Control through breeding of the leaf-roll disease of potatoes. Illustr. Landw. Zeitg. **37**: 341–342, 1917. (Zeitschr. Pflanzenkrank. **29**: 54, 1919.)

The author makes distinctions between hereditary and non hereditary leaf-roll. The latter is due to *Fusarium.*

Beiträge zur Kenntnis des Kartoffelabbauses. (Contribution to the knowledge of deterioration in potatoes.) Ztschr. Pflanzenkrank. **29**(5–6): 171–176, 1919.

The author states that very insignificant difference in hydrogen-ion

concentration may have marked effect on metabolism. He found in his experiments that without exception the cell sap of sound plants showed appreciably more acidity than diseased plants in regard to catalase, his experiments gave obvious differences.

Bohm, F.

Die züchterische Bekämpfung der Blattroll krankheit. (The breeding against leaf roll disease.) Ill. Landw. Zeitung. No. 52, 1917.

Bohme, R. W.

Einige Fälle spontaner Infektion mit echtem tabak—Ring flecken—Virus. (Some cases of spontaneous infection with the true tobacco ring spot virus.) Phytopath. Zeitschr. **6**(5): 507–515, 1933.

Report of observations of development of a virus apparently identical to ring spot on tobacco. Information in regard to mechanical transmission, no insect transmission of this disease has apparently been recorded

Vergleichende Unterasuchungen mit Stämmen des "X" und "Y" virus. (Comparative studies on strains of the "X" and "Y" viruses) Phytopath. Zeitschr. **6**(5): 517–534, 1933.

In his experimental work the author differentiated four "X" viruses on potatoes and three distinct forms of the "Y" virus on the basis of their effects on various hosts of which *Nicotiana sylvestris* and *Solanum aculeatissimum* showed the most characteristic symptoms. Other very valuable data is included as to transmission experiments.

Bohutinsky, G[ustav]

Beiträge zur Erforschung der Blattrollkrankheit. (Contribution to the investigations on leaf-roll disease.) Monastchefte fur Land-Wirtschaft. Jahrg. **2**(4): 118–130, 1909. (Zeitschr. fur das Land-Wirtschaft. Versuchswesen in Oesterreich, Jahrg. **13**(7): 607–633, 1910.)

Bolas, Bemard D., & Bewley, W[illiam] F[leming]

Aucuba or yellow mosaic of the tomato. II note on the metabolism. Nature **126**(3178): 471, 1931.

The authors suggest that the virus acts on the starch to form (1) nitrogen and protein, (2) attacks the chlorophyll and causes a mottling and (3) reacts on the respiration of the plant.

Physiological investigations of mosaic disease in the garden tomato. Expt. & Res. Sta. Cheshut Herts. **16**: 62–67, 1930.

A study of the influence of temperature and light. The period of incubation varies with the mottle type by temperature and light. The most pronounced mosaic was with blue-green light.

Physiological investigations of mosaic disease. Expt. & Res. Sta. Cheshut Herts. **17**: 47, 1932.

The virus in the living tissue can be destroyed by the passage of a direct electric current of 5.0 microamps. per sq. cm. of tissue.

Bonazzi, Augusto

Study on sugar cane mosaic. Science n.s. **64**(1665): 529–530, 1926. (Rev. Appl. Mycol. **6**(3): 184–185, 1927.)

The author describes a method of inoculating sugar cane by drilling a hole into healthy cane and inserting a plug of corresponding size cut from a mosaic cane.

Boncquet, P[ierre] A[uguste] & Hartung, W[illiam] J[ohn]

The comparative effect upon sugar beet of *Eutettix tenella* Baker from wild plants and from curly top beets. Phytopathology **5**(6): 348–349, 1915.

This is a brief note giving the results of experiments. Insects from curly top beets carried the disease to healthy beets. Insects from wild uninfected plants did not produce the disease until after having fed on diseased beets.

Presence of nitrates and ammonia in diseased plants. Its significance with regard to crop rotation and soil depletion. Journ. Amer. Chem. Soc. **38**(11): 2572–2576, 1916.

Wild vegetation as a source of curly-top infection of sugar beet. Journ. Econ. Ent. **10**(4): 392–397, 1917.

Bacillus morulans n. sp. A bacterial organism found associated with curly top of the sugar beet. Phytopathology **7**: 269–289, 1917.

No proof that this organism is the cause of the disease. This paper gives the results of extensive studies on an organism found in sugar beets.

Discovery of curly leaf of sugar beet in the Argentine Republic. Phytopathology **13**(10): 458–460, 1923.

Also reported the finding of *Entettix tenella*.

Bonde, R.

The spread of spindle tuber by the knife. Amer. Pot. Journ. **4**: 51–52, 1927.

Popular.

Böning, K[arl]

Die Mosaikkrankheit der Rübe. (Mosaic disease of beet.) Forchungen usw. Heft **3**: 81–128, 1926. (Ztschr. Pflanzenkrank. Bd. **37**: 19–15, 1927.)

Uber die Wechselseitige Uebertragbarkeit der Mosaikkrankheiten von Rübe und Spinat. (Reciprocal transmission of beet and spinach mosaic.) Centr. Bakt. II Abt. **71**: 490–497, 1927.

Spinach mosaic was transferred to beets by *Aphis fabae* and *Macrosiphum* sp. Spinach mosaic was transferred to spinach by inoculation but beet mosaic could not be transferred in this manner

Die Kalifornische Blattrollkrankheit der Rübe. (California leaf-roll disease of sugar beet.) Centr. Bkt. II Abt. **72**(15–24): 379–398, 1927.

A review of the literature on curly top and mosaic of the sugar beet.

Die Mosaikkrankheit der Ackerbohne *Vicia faba* L.) (The mosaic disease of broad beans (*Vicia faba* L.) Forsch. Gebtet. Pflanzen. Kr. **4**: 43–111, 1927.

---------, **& Schaffnit, [Johannes Martin] E[rnst Christian Otto]**

Die Mosaikkrankheit der Rübe. (The mosaic disease of beet.) Zeitschr. des Vereins der Deut. Zuck-Indust. Bd. **77**, 1927. (Technisches Teil. Heft **844**: 13–72, 1927. Forsch. Geb. Pflanzenkrank. **3**: 8–128, 1927. Zeitschr. Pflanzenk, **37**(1–2): 19–35, 1927.)

Panaschierung und Mosaikkrankheit. (Variegation and mosaic disease.) Gebt. Pflanzen. u. d. Immu. in Pflanzenrich Heft. **4**: 16–22, 1927.

Uber den gegenwärtigen Stand einiger die Erforschung der Viruskrankheiten betreffenden Fragen. Prakt. Blätt Pflanzenb. u Schutz. **5**: 33–42, 1927.

Die Mosaikkrankheit des Tabaks. An die: Bericht über des Auftreten von Krankheiten und Schädlingen am Tabak im Jahre 1927. (The mosaic disease of tobacco. In his Report on the diseases and pests occurring during the year 1927.) Arb. aus der Bayer. Lands. Pflanzenb. Pflanzen sch. Heft 4: 36–40, 1928.

Account of the occurrence of the disease, discussion and comparative data of other workers on the subject.

Ist die durch die Blattwanze (*Piesma quadrata* Fieb.) hervorgerufene Erkrankung des Rübe eine Viruskrankheit? Anzeigq. Schädlingskunde 4: 8–10, 1928.

Beobachtungen aus der Praxis über die wechselnde Aüspragung der Merkmale der Mosaikkrankheit der Kartoffel im Verlaufe der vegetationsziet. (Field observations on the variations of the symptoms of potato mosaic disease during the growing season.) Blätter Pflanzenb. n. Pflanzenschutz 5(12): 308–315, 1928.

A study of the masking of symptoms with reference to its bearing on inspection.

Beiträge zum Studium der Infektionsvorgänge pflanzenzlicher Viruskrankheit. I. Mitteilung. (Contribution to the study of the infection processes of the virus diseases of plants. Part I.) Zeitschr. fur Prasitenkunde 1(1): 198–230, 1928. (Rev. Appl. Mycol. 7: 659–660, 1928.)

The author discusses the rate of spread of the virus and the results of double inoculations.

Insecten als Ueberträger von Pflanzenkrankheiten. (Insects as carriers of plant diseases.) Zeitschr. Angew. Ent. 15(1): 1929.

Krankheiten, Schädlige und Witterungsschaden am Tabak im Jahre 1929. Prakt. Blatt. Pflanzend. u. Schuts. 8: 27–33, 1930.

Deformationskrankheit an Rübe und Spinat. (Deformation disease on beet and spinach.) Zeitschr. Pflanzenk., Pflanzenpath. u Pflanzenschut. 40(7): 315–323, 1930.

A description of a leaf deforming diseases of beets and spinach, *Rumex obtusifolius* and *R. crispus.* It is transmitted by *Aphis rumicis* and *Mysus persicae.*

Zur Atiologie der streifen-und Krauselkrankheit des Tabaks. (On the etiology of the stripe and curl disease of tobacco.) Zeitschr. fur Parasitenkunde **3**(2): 103–141, 1931.

Description of the disease with full account of these studies. Believes that these diseases are carried in the soil. No evidence of seed transmission. Inoculated both diseases into *Nicotiana tabacum N. macrophylla* and *N. rustica.*

Booberg, K. G.

De bergbibitaanplant op Java. (The cultivation of mountain sets in Java.) Arch. voor Java Suikerindustrie. Deel II **40**(37): 761–767, 1932.

The serch disease is of no importance owing to the use of resistant varietes. The hill nurseries are decreasing.

Borg, P[aul]

Appendix F. Report of the Plant Pathologist. Reports on the working of (Multa) Govt. Depts. during the financial year **1927–28**, p. T15–T16, 1929. (Rev. Appl. Mycol. **9**(3): 158, 1930.)

Borisevich, G. F.

(The mosaic of the leaves of the sugar beet.) In V. P. Muraviov. Mozaichnye Bolezni Sakharnoi Svekly (Mosaic diseases of sugar beet.) Kiev, SS. U. Soiuzsakhara p. 141–160, 1930. (English Abstract p. 158–160.)

Sugar-beet leaf mosaic is very common in Ukrania ranging from 15 to 100 per cent on mother beets and from 0.5 to 100 per cent on first year beets. The author also discusses carriers, wild hosts, sugar content, deterioration and insect control.

Bouriquet, A. G.

La rosette de l'arachide á Madagascar. (Peanut rosette disease in Madagascar.) Agron. Colon. **20**(160): 105–108, 1931.

A disease which appears to be the same as the one reported from Africa.

Les maladies du Manioc á Madagascar. (Cassava disease in Madagascar.) Rev. Path. Veg. & Ent. Agric. **19**(8–9–10): 290–297, 1932.

Brief morphological and economic account of the chief diseases in Madagascar, among which mosaic disease of cassava is discussed, giving control methods.

Bouygues, H[enri]

Sur la Nielle des feuilles du Tabac. (La "Nielle" of tobacco leaf.) Compt. Rend. **137**: 1303–1305, 1903.

————————, **& Perreau**

Contributions a l'étude de la nielle des feuilles de Tabac. (Contribution to the study of "La Nielle" of the tobacco leaves.) Compt. Rend. **139**: 309, 1904.

Bovell, J[ohn] R[edman]

Sugar cane mosaic. Barbados Dept. Agric. Ann. Rpt. **1921–1922**: 19, 1922.

Boycott, A. G.

The transmission from life to death: The nature of filterable viruses. Smithson. Inst. Ann. Rpt. **1929**: 323–343, 1929. Proc. Roy. Soc. Med. Path. Sect. **22**(1): 55–69, 1929. Nature **123**: 91–98, 1929.) (Proc. Roy. Soc. Med. London 22(1): 55–69, 1929.)

Bradford, F. C., & Joley, Lloyd

Infectious variegation in the apple. Journ. Agric. Res. **46**(10): 901–908, 1933.

The authors refer to a paper reporting infectious variegation of apple published in France before 1835. They report the occasional occurrence of the disease in United States. Description of the behaviour of the disease.

Brandenbourg, E[rnst]

Die Mosaikkrankheit (Gelbfleckigkeit) des Spinats und ihre Ubertragung durch Insecten. (The mosaic disease (Yellow spot disease) of spinach and its transmission by insects.) Zeitschr. Pflanzenkrank u. Schutz. **37**(5–6): 173–182, 1927.

Ueber Mosaikkrankheiten an Compositen. (Mosaic disease of Compositae.) Forsch. Gebiet Pflanzenkr. **5**: 39–72, 1929.

A discussion of a mosaic of *Lactuca sativa* var *capitata* and *Dahlia variabilis* and of mottling of some other members of this family.

Brandes, E[lmer] W[alker]

The mosaic disease of sugar cane and other grasses. U.S.D.A. Bull. **829**, 26 p., 1919. (Minist. Agric. Indus. Com. ser. Inf. Rio de Janeiro 33 p., 1926.)

Gives a history of the disease, distribution and losses in the United States, symptoms, varietal susceptibility, other hosts, nature of the disease methods of transmission and methods of control.

Artificial and insect transmission of sugar-cane mosaic. Journ. Agric. Res. **19**(3) : 131–138, 1920.

Gives the results of series of experiments demonstrating that sugar cane mosaic is transmitted by *Aphis maidis*.

Mosaic disease of corn. Journ. Agric. Res. **19**(10) : 517–522, 1920.

Gives the symptoms and distribution of the disease. Also experiments showing that *Aphis maidis* is a carrier.

Mechanics of inoculation with sugar-cane mosaic by insect vectors. Journ. Agric. Res. **23**(4) : 279–283, 1923.

Gives a review of the literature and describes the mechanics of inoculations.

----------, & Klaphaak, Peter J[ohn]

Cultivated and wild hosts of sugar cane or grass mosaic. Journ. Agric. Res. **24**(3) : 247–262, 1923. (Rev. Appl. Mycol. **2** : 584–585, 1923. Rev. Appl. Ent. ser. A **11** : 449, 1923.)

Gives the result of testing 40 species of grasses to determine their susceptibility to mosaic. Makes statement that thirteen species of grasses are susceptible to the virus of sugar-cane mosaic. Give the esults of inoculation experiments.

Growth stimulation and pest and disease c ntrol by hot-water treatment of sugar-cane seed. Louisiana Planter **71**(19) : 371–372, (20)392–394, (21)412, 1923. (Rev. Appl. Mycol. **3** : 301–302, 1924.)

Hot water treatment had no effect on sugar-cane mosaic.

Breeding of diseases resistant sugar plants for America. Ref. Book Sugar Indus. of the World, July 1923.

Mosaic's role in limiting Louisiana yields. (El rol de la enfermedad del mosaico en limitar los rendimientos de Luisiana.) Rev. Indus. Agric. de Tucumán **15**(1–2) : 29–33, 1924. (Facts About Sugar **18**(26) : 610–611, 1924, Int. Sugar Journ. **26** (311) : 581–582, 1924.)

Mosaic is one of the many factors causing low yields. This is a popular paper containing much valuable data.

Kavangerie sugar cane in Puerto Rico. Facts About Sugar **21** (18) : 422–424, 1926.

Potash not a Panacea. Facts About Sugar **25**(19): 472, 1930.

Controversial Reply to Mr. Otto Hasch in regard to the use of potash to cure sugar cane mosaic disease.

Breeding for resistance to mosaic. Facts About Sugar **26**(11): 490–493, 1931.

Reports that *Saccharum robustum* from Papua appears to be free from mosaic. The disease was found in Papua on several varieties of *S. officinarum* and on *Coix lachryma jobi*. The author also reports it on a number of hybrid varieties.

Breda de Haan, J[acob] von

Eene nieuwe suikerriet ziekte in W. Indie. (A new sugar cane disease in the West Indies.) Teysmania **4**: 544–548, 1893.

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De gele strepenziekte bij suikerriet. (Yellow stripe disease on sugar cane.) Teysmania **4**: 511–522, 1893.

Voorloopige mededeeling over het Peh Sem der Mosaiickziekte bij de Deli Tabak. Teysmania p. 567–584, 1899.

Breemen, P[ieter] J[ohan] von

Eenige Waarnemingen Omtrent het zwermen van *Aphis maidis* Fitch. (Some observations concerning the migrations of *Aphis maidis* Fitch.) Arch. Meded. Java Suikerind. **18**: 513–543, 1926. (Facts About Sugar **21**(39): 919, 1926.)

Gives the results of traping the insect which indicates that they have definite periods for migration. The sudden outbreaks of the disease are correlated with the periods. Agrees with J. Alfaro from Cuba.

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Strepenziekte en bladluizen. (Stripe disease and leaf lice.) Arch. Java Suikerind. **1926**: 910–912, 1926.

Aphis maidis op suikerriet bij Pasoervean. (*Aphis maidis* on sugar cane at Pasoervean.) Arch. Java Suikerindus. **35**(3): 557–577, 1927.

This paper reports a continuation of the author's studies on the swarming of *Aphis maidis*. The author recommends the roguing of the field in advance of the swarming so as to remove the centers of infection.

Verdere waarnemingen omtrent het zwermen van *Aphis maidis* Fitch. (Further observations on the migrations of *Aphis maidis* Fitch.) Arch. Meded. Java **35**: 583–588, 1927.

Proven over strepenziekte met Klaboes in het vije veld. (Yield despite stripe disease in five fields at Klaboes.) Arch. Java Suikerindus. **13**: 579–582, 1927.

Brehmer, G[ustav] von

Die anatomische und mikrochemischen veränderungen der Kartoffelleptoms. (The anatomical and microchemical changes in the leptome of the potato.) Rept. Inter. Conf. Phytopath. & Econ. Ent. Holland **1923**: 79–85, 1923.

The author discusses necrosis, obliteration, and necrobiosis. Necrobiosis is an old age character of both normal and diseased plants. Necrosis is a character of leafroll plants. Obliteration is a character of plants that are dying after maturity.

Der Einfluss der Kalidüngung auf die Blattrollkrankheit der Kartoffell. (The influence of potash fertilization on the leaf roll disease of potato.) Ernährung d. Pflanze **20**: 12, 1924.

Een cytologisch onderzoek van Strepenziekte bij Zuikerriet en andere planten. (A cytological study of stripe disease of sugar cane and other plants.) Meded. Proefst. Java Suikerindus. **11**: 337–371, 1926. (Rev. Appl. Mycol. **5**(12): 765–766, 1926.)

The author reports the finding of intracellular bodies in mosaic disease of sugar cane and gives a general discussion of the subject.

----------, **& Barner, J.**

Uber die Viruskrankheiten der Kartoffel. (On the virus diseases of the potato.) Biol. Reichst. f. Land-und Forst. **18**(1): 1–56, 1930.

Biologische Bekampfungsmethoder der Viruskrankheiten. (Biological methods to combat virus diseases.) Forstschitte der Medizin **49**(8). 1931.

Uber die Viruskrankheiten verschiedner Kulturpflanze. (On virus diseases of different cultivated plants.) Second Int. Congr. Comp. Path. (Paris) p. 365, 1931.

Vergleichende Pathologie und Biologische Bekämpfungsmethoden der Viruskrankheiten im allgmeinen. (Comparative biological and pathological methods to combat virus diseases in general.) Second Int. Congr. Comp. Path. (Paris) **2**: 358–362, 1931

---------, & **Rochlin, Emilia**

Histologische und mikrocheminsche Untersuchungen über pathologische Gewebeveränderungen viruskranker Kartoffelstanden. (Histological and microchemical investigations on the pathological changes of the tissues of virus-diseased potato plants.) Phytopath. Zeitschr. **3**(5): 471–498, 1931.

The authors give evidence that nutritional disturbances give symptoms similar to those resulting from virus diseases.

Les maladies á virus de diverses plantes cultivées. (Virus diseases of different cultivated plants.) Deuxiéme Congr. Inter. Path. Comp. (Paris) **1**: 355, 1931.

Brewer, P[earl] H[arvey,] Kendrick, J[ames] B[lair,] & Gardner, Max W[illiam]

Effect of mosaic on carbohydrate and nitrogen content of the tomato plant. Phytopathology **16**(11): 843–851, 1926.

Chemical studies which show that soil conditions did not materially affect the two diseases. In most cases there was a reduction of total weight and in all cases a reduction of carbohydrates as a result of mosaic. No reduction in nitrogen content.

------------, **Kraybill, H[arry] R[eist,] &** ------------

Purification of the virus of tomato mosaic. Phytopathology **17** (10): 744, 1927.

A description of two methods which the authors believe to be an improvement over past methods.

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Purification and certain properties of the tomato mosaic virus. Phytopathology (Abstract) **19**(1): 108, 1929.

----------, -----------, **Samson, R[ayburn] W[alter,] & Gardner, Max W[illiam]**

Purification and certain properties of the virus of typical tomato mosaic. Phytopathology **20**(12): 943–950, 1930.

This paper is a continuation of previous work, effect of different filters, temperature and pH concentration on the virus is discussed.

Brick

Neues uber die Blattrollkrankheit der Kartoffel. (News about the leaf-roll disease of the potato) Krog Ratgeb. Obst-u Gartenb **4**, No 4, 1924

Brierley, Philip

Studies on mosaic and related diseases of dahlias Contr. Boyce Thompson Inst **5**(2) 235–288, 1933

Extensive and careful experimental work performed in partial fulfilment of the requirements for the degree of Doctor of Philosolophy in the Graduate School of Cornell University

Virus diseases of Dahlia Phytopathology (Abstract) **23**(1) 6, 1933

Different types of the disease are discussed as well as its insect vector (*Myzus persicae*) and other ways of transmission

Dahlia mosaic and its relation to stunt Bull Amer Dahlia Soc **9**(65) 6–11, 19, 1933

Cross inoculation on virus diseases of dahlia, which the author states is not synonymous with "stunt" Notes on the transmissibility and control of the disease

------------, & **Mc Whorter, Frank P.**

A mosaic disease of bulbous iris Phytopathology (Abstract) **24**(1) 4, 1934

Brierley, W[illiam] B[roadhurst]

On a case of recovery from mosaic disease of tomato Ann. Appl Biol **2**(4) 263–266, 1916.

Economic importance of virus diseases of plants. Brit Soc Adv Sci Rpt (Abstract) **91** 493, 1923

Brittlebank, C[harles] C.

Tomato diseases Victoria Dept Agric Journ **17** 231–235, 498–500, 1919, **18** 413–416, 1920

A description of the spotted wilt of tomato

Britton-Jones, H R.

Stripe disease of corn (*Zea mays* L.) in Trinidad Trop Agric. (Trinidad) **10**(5) 119–122, 1933

The author observed since 1929 a stripe disease of corn which occurred in Trinidad and closely resembling that described by Stahl in Cuba[4] That disease was associated with the leafhopper *Peregrinus maidis* as vector, both in Cuba and Tanganyka The author describes

the disease and his observations on inoculation studies. A similar disease resembling the one under discussion was observed also on sorghum.

Brock, J. A.

Cause of mosaic disease discovered by science. Facts About Sugar **16**(1): 14–15, 1923.

Review of Nelson, Kunkel and Mc Kinney's work, on bodies associated with mosaic disease.

Brooks, A[rchibald] J[oseph]

Causes of mosaic discovered by science. Facts About Sugar **16**: 14–15, 1923.

Popular reference to works by Nelson, Kunkel and McKinney.

Report on the Agricultural Department, St. Lucia. Imp. Dept. Agric. West Indies Rpt. Agric. Dept. St. Lucia **1918–1919**, 32 p., 1920.

Rosette disease investigations. Gambia Dept. Agric. Ann. Rpt. **1927–28**: 11–16, 1928.

Annual Report of the Department of Agriculture, Colony of the Gambia, for **1928–29**, p. 54, 1929. (Rev. Appl. Mycol. **9**(1): 20. 1930.)

Annual Report of the Department of Agriculture, Colony of Gambia, for the year ending March 31st, **1932**, 18 p., 1932.

The rosette of the peanuts is not carried in the seed. Many other plants, such as *Petunia, Vinca, Calliopsis, Calendula, Chrysophyllum Cainito* and *Lagerstroemia,* show symptoms. The vectors is *Aphis labruri (A. Leguminosae).* The author also reports a chlorosis which can be transmitted.

Brooks, C[harles], & Fisher, D. F.

Jonathan spot, bitter pit and stigmonose. Phytopathology **4** (6): 402–403, 1914.

Description of these diseases, in that date the true cause of bitter pit was not known.

Irrigation and bitter pit. Phytopathology (Abstract) **6**(1): 111, 1916.

Brooks, F[rederick] T[om]

Virus diseases of plants. Nature **112**(2826): 955, 1923.

This paper is a review and discussion of papers by Murphy, Quanjer, Whitehead and Salaman.

Brown, B[enjamin] A[rthur]

The causes of degeneration of Irish potato in Connecticut. Connecticut (Storrs) Agric. Expt. Sta. Bull. **160**: 325–380, 1929.

The author gives the results of field studies over the period from 1922 to 1928 which shows conclusively that mosaic, leaf roll, spindle tuber and similar diseases are the chief causes of potato degeneracy in Connecticut.

Degeneration of potatoes in Connecticut. Amer. Potato Journ. **7**(5): 140–142, 1930.

A popular discussion of the subject.

Brown, N[icholas] E[dward]

Abutilon Thompsonii and other species. Gard. Chron. **48**: 427. 1910.

Brown, W[illiam], & Blackman, V[ernon] H[erbert]

Field experiments on the deterioration of the Scotch potato seed in England. Ann. Appl. Biol. **17**(1): 1–27, 1930.

Data is given of the results obtained in the experiments. The main fact is that virus disease affects to a great extent the potato seed and the early lifting or shading has no marked effect of a purely physiological nature.

Bruner, S[tephen] C[ole]

Notas sobre la enfermedad del mosaico de la caña de azúcar. (Notes on sugar-cane mosaic disease.) Rev. Agric. Com. & Trab. Cuba **2**(9): 532–533, 1919.

The disease is infectious in character. Healthy plantings became infected from nearby diseased plantings.

La enfermedad del mosaico o de rayas amarillas de la caña de azúcar en Cuba. (The mosaic or yellow stripe disease of sugar cane in Cuba.) Rev. Agric. Com. & Trab. Cuba **2**(9): 437–441, 1919.

Record of the occurrence of the disease and a review.

Algunas observaciones sobre la enfermedad del "mosaico" o "rayas amarillas" de la caña de azúcar. (Some observations on the "mosaic" or "yellow stripe" disease of sugar cane.) Rev. Agric. Com. & Trab. Cuba **4**(6): 616–620, 1921.

A review of work on resistant varieties in Puerto Rico, Hawaii and Jamaica. Gives a list of susceptible and resistant varieties.

Exploración biológica y fitopatológica en la Provincia de Pinar del Río. (Biological and fitopathological exploration in the Province of Pinar del Río.) Rev. Agric. Com. & Trab. Cuba **5**(4): 27, 1922.

Records the occurrence of mosaic disease on sugar cane in Taco Taco in the Province of Pinar del Río, Cuba.

Sobre la trasmisión de la enfermedad del mosaico o rayas amarillas en la caña de azúcar. (On the transmission of mosaic or yellow stripe disease of sugar cane.) Rev. Agric. Com. & Trab. **5**(1): 11–22, 1922.

Bibliografía. La enfermedad de las "rayas amarillas" en la caña. (Bibliography. The sugar-cane "yellow stripe" disease.) Rev. Agric. Com. & Trab. Cuba **5**(2): 32–33, 1922.

A review of a paper by Simonetto

El mosaico y otras enfermedades y plagas de la caña en Cuba. (Mosaic and other cane diseases and pests in Cuba.) Mundo Azucarero **2**(1): 20–27, 1923. (Louisiana Planter **70**(22): 452–455, 1923. Rev. Appl. Mycol. **2**: 523–524, 1923.)

The mosaic does not appear to spread as rapidly in Cuba as in Puerto Rico. Recommends the use of resistant and immune varieties.

La enfermedad del mosaico de la caña de azúcar. (Mosaic disease of sugar cane.) Cuba Est. Expt. Agron. Circ. **60**, 16 p., 1923 (Facts About Sugar **18**(14): 329, 1924.)

A discussion of conditions in Cuba.

La enfermedad del mosaico de la caña de azúcar. (Mosaic disease of sugar cane.) Argentina, Ind. Azucarera **29**(366): 228–237, 1924.

Sobre el daño que ocasiona el "mosaico" a la caña de azúcar. (On the damage caused by "mosaic" to sugar cane.) Cuba Est. Expt. Agron. Circ. **61**: 3–14, 1925.

La situación respecto al "mosaico" de la caña de azúcar en Jamaica. (The situation in regard to sugar-cane mosaic in Jamaica.) Rev. Agric. Com. & Trab., Cuba **8**(1): 74–76, 1926. (Agricultura (Santiago de las Vegas) **1**(1): 160–162. 1925.)

Brunnich, J. C.

Report of the Agricultural Chemist. Queensland Dept. Agric & Stock, Ann. Rpt. **1923**: 28–31, 1924.

Notes on bunchy top disease of bananas.

Bryant, M. W.

Report on the conference on the phony peach disease held at Memphis, Tennessee, on December 13, 1932. Trans. Illinois Hort. Soc. **66**: 217–226, 1933.

Objections to quarantine pointed out. It was argued that the disease is controllable by eradication and destruction of infested trees and that it is not transmissible by propagation.

Bryce, G.

The "bunchy top" plantain disease. Dept. Agr. Ceylon, Leaflet **18**, 2 p., 1923.

Popular.

Buchwald, N. F.

Omm virussy gdomme hos planterne. (On the virus diseases of plants.) Naturens Verdens **1933**, p. 447–470, 1933.

Brief historical sketch of researches on virus diseases of plants and discussion of the various aspects of the problem now undergoing investigations. Review of the most recent work.

Bunzel, H[erbert] H[orace]

A biochemical study of the curly-top of sugar beet. U.S.D.A. Br. Plant Indus. Bull. **277**, 27 p., 1913.

(The role of oxidases in curly-top of sugar beets.) Biochem. Ztschr **50**(3–4): 185–208, 1913.

Oxidases in healthy and in curly dwarf potatoes. Journ. Agric. Res. **2**(5): 373–404, 1914.

Chemical and physiological studies with special reference to the oxidase activity of the plants.

Oxidase reaction in healthy and blighted spinach. Journ. Agric. Res. **15**(7): 377–380, 1918.

Report of the results obtained in his studies on the subject. He states that the results obtained resembles those obtained in several other plant diseases. In the case of the mosaic of tobacco, leaf-curl of potatoes, curly-top of sugar beets and curly dwarf of potatoes the diseased material shows a greater power to transfer atmospheric oxygen to certain aromatic compounds than the healthy plants.

Burger, O[wen] F[rancis]

Report of the Plant Pathologist. Florida Agric. Expt. Sta. Ann. Rpt. **1920–21**: 25 R–28 R, 1921.

Brief notes on mosaic disease of several economic plants.

Report of the Plant Pathologist. Florida Agric. Expt. Sta. Ann. Rpt. **1922–23**: 52 R–102 R, 1923.

Notes on mosaic disease of several economic plants. Some of them are records. Sweet potato mosaic is discussed to some extent.

Report of the Plant Pathologist. Florida Agric. Expt. Sta. Rpt. **1924–25**, 1925.

First record of eggplant mosaic disease.

Burkholder, W[alter] H[agemeyer]

Bean diseases in New York State in 1916. Phytopathology (Abstract) **7**(1): 61, 1917.

\-\-\-\-\-\-\-\-\-\-\-\-\-, **Hawley, I[ra] M[yron,] & Lindstrom, E[rnest] W[alter]**

Some results of the New York State bean investigations. Proc. New York Fruit Growers' Ass'n. 17th Ann. Meeting **17**: 120–125, 1918.

\-\-\-\-\-\-\-\-\-\-\-, **& Muller, A[lbert] S[tanley]**

Hereditary abnormalities resembling certain infectious diseases in beans. Phytopathology **16**(10): 731–737, 1926.

This paper includes a discussion of a disease which resembles mosaic. It is designated as a "pseudo mosaic."

Burnett, G[rover,] & Jones, Leon K[ilby]

In contrast with seedling stock, apparently healthy potato tubers are virus carriers. Phytopathology (Abstract) **20**(10): 854–855, 1930.

The effect of certain potato and tobacco viruses on tomato plants. Washington Agric. Expt. Sta. Bull. **259**, 37 p., 1931.

This paper gives the results of very interesting experiments. It is especially valuable for the data on latent viruses.

The distribution of the latent virus in tubers of commercial potatoes. Phytopathology (Abstract) **21**(1): 104, 1931.

The longevity of the latent and veinbanding viruses of potato in dried plant tissue. Phytopathology **24**(3) : 215–227, 1934. (Washington Agric. Expt. Sta. Sci. Paper **257**.)

Trials of inoculation of dried inoculum on tobacco and tomato plant, giving the results.

Stunt-A virosis of Delphinium. Phytopathology **24**(5) : 467–481, 1934.

The author describes the disease of Delphinium known as "stunt" or witches broom. The disease has been transmitted mechanically to several species of plants, but the insect vector has not yet been determined.

Busch, Hans J., & Wolf, Frederik A.

Manufactured tobacco, a source of inoculum for mosaic in flue-cured tobacco. Phytopathology **23**(10) : 839–841, 1933.

Brief report of the results of investigations of manufactured tobacco as source of inoculum for mosaic in flue-cured tobacco.

Busch, W.

Die mosaikkrankheit der Zukerrübe. (The mosaic disease of sugar beet.) Osteurop. Landw. Zeitg **4**, No. 6, 1927.

Butler, E[dwin] J[ohn]

Report on "spike" disease among sandalwood trees. Indian For. App. Ser. **29**(1) : 1–11, 1903.

Some characteristics of the virus diseases of plants. British Med. Journ. **1922** : 963–964, 1922. (Sci. Prog. **17**(67) : 416–431, 1923.)

Classifies the virus diseases into four groups. Gives a general discussion of the problems.

Virus diseases of plants. Proc. Pan Pacific Sci. Congr. **1** : 143–149, 1923.

Report of some diseases of the tea and tobacco in Nyasaland. Nyasaland Dept. Agric. Ann. Rpt. **1928** : 30, 1929.

Butler, O[rmond Rourke]

Effect of size of seed used in commercial planting on the incidence of leaf-roll and mosaic in potatoes. Journ. Amer. Soc. Agron. **22**(1) : 75–77, 1930.

A brief record of some experimental work.

-------------, & **Murray, H. L.**

Effect of nitrate of potash on the vigor and productivity of healthy and leaf roll. Green mountain potato plants and their progenies. Journ. Amer. Soc. Agron. 24(11): 881–887, 1932.

Report of results of experiments. In conclusion it was noticed that nitrate of potash applied to some of the cultures not only increased yields but also resulted in loss of vigor in the progeny of the fertilized plants.

Button, H[arry] F[reeman]

Scoundrel in stripes. Gard. Mag. **34**: 108, 116, 1921.

Caesar, L[awson]

Peach diseases. Peach yellows and little peach. Ontario Dept. Agric. Bull. **201**: 43–59, 1912.

Some little known but destructive diseases reported. Ontario Agric. Coll. & Expt. Farm. Ann. Rpt. **38**: 28, 1912.

A record of raspberry yellows and tomato mosaic.

Some data on peach yellows and little peach in Ontario. Phytopathology (Abstract) **10**(5): 318, 1920.

Caldwell, John

The physiology of virus diseases in plants. I. The movement of mosaic in the tomato plant. Ann. Appl. Biol. **17**(3): 429–443, 1930.

The movement in the plant of the causative agent of virus disease is discussed. The relevant data in the literature is summarized.

This paper gives the results of experiments which demostrated that the virus it not carried in the xylem.

The physiology of virus diseases in plants. II. Further studies on the movement of mosaic in the tomato plant. Ann. Appl. Biol. **18**(3): 279–298, 1931.

Experiments with aucuba mosaic in tomato are discussed. These results support the general thesis that the causative agent does not normally travel in the xylem stream.

Studies in the physiology of virus diseases in plants. III. Aucuba or yellow mosaic of tomato in *Nicotiana glutinosa* and other hosts. Ann. Appl. Biol. **19**(2): 144–152, 1932.

When the aucuba or yellow mosaic of tomato is injected into *Nicotiana glutinosa* and *Datura stramonium* the symptoms are different from those produced by this little multiplication of the virus.

The physiology of virus diseases in plants IV The nature of tomato Ann Appl Biol **20** (1)100–116, 1933

The author summarizes this paper as follows "In this paper the symptoms of aucuba mosaic of tomato in *N glutinosa* are described A method is discussed whereby it is possible to count the spots formed after inoculation with juice diluted to different strengths The fact that the number of spots formed is proportional to the amount of dilution is taken as indication the number of virus particles present in the juice It is shown that the amount of virus present in the juice does not increased after agitation or after treatment with proteolytic enzymes With trypsin and diastase they were decreased. This decrease it is suggested, is due to the absorption rather than to the destruction of the virus The amount of multiplication of the virus in the tissues of *N glutinosa*, is examined and compared with the much greater multiplication in tomato tissues

The physiology of the virus diseases in plants V The movement of the virus agent in tobacco and tomato Ann Appl. Biol **21**(2) 191–205, 1934

The author reports the results of experiments on the movement of the virus of aucuba or yellow mosaic of the tomato Also of experiments on the transmission of six different viruses in the seed of tomato or tobacco, which were negative The author suggests that the chances of seed transmission of these viruses are very slight Other observations are given and concludes that the virus apparently moves in the direction opposite to that of the metabolites

The physiology of virus diseases in plants VI Some effects of mosaic on the metabolism of the tomato Ann Appl Biol. **21**(2) 206–224, 1934

The author revises the literature dealing with the effect of virus diseases on the metabolism of the host plants He reports the results of his experiments and observations on the aucuba or yellow mosaic in tomato According to the author the metabolism of the plant is not affected during the stage of development He found that the respiration process is somewhat affected by the disease, the output of CO_2 by the host tissues is higher than the healthy ones This is attributed to an increase in the efficiency of the enzyme system of the diseased plants

Calinissa, M. R

The occurrence of bunchy-top and root knot in Abacá. Phil. Jour. of Agric **2**(2) 121–127, 1931

Plants of *Musa textilis* may be infected with both diseases which causes some confusion

Attempts to re-establish abacá plantation in Cavite, previously wiped out by bunchy top. Philippine Journ. Agric. **2**(3): 209–221, 1931.

The efforts have not been encouraging. Ten introduced varieties are more of less susceptible. The use of fertilizer was not successful.

Caluwe, P. de

(The leaf curl of potatoes.) Handel. Vlaamsch Natuur en Geneesk Cong. **12**(2): 195–200, 1922.

Calvino, Mario

Informe de los años 1918, 1919 y 1920 de la Estación Experimental Agronómica, Santiago de las Vegas, Cuba. (Annual Report for the years 1918, 1919 and 1920 of the Agricultural Experiment Station, Cuba). pp. 547–550, 1920.

Doce puntos relacionados con el mosaico de la caña y el modo de combatirlo. (Twelve points related to sugar cane mosaic disease and methods to control it.) Rev. Agric. Com. & Trab. Cuba, **5**(12): 6–7, 1924.

Nuevas orientaciones en la selección de caña para semilla. (New orientations in sugar cane seed selection.) Rev. Agric. Com. & Trab. Cuba, **5**(12): 8–10, 1924.

Campbell, D. Curl

Communications to the Board of Agriculture. **3**: 219, 1802.

Campbell, E[lmer] G[rant]

Potato leaf-roll as affecting the carbohydrate, water and nitrogen content of the host. Phytopathology **15**(7): 427–430, 1925.

A brief paper giving the results of studies indicated in the title.

Camuñas, Manuel

Report of the Commissioner of Agriculture and Labor, 19th Ann. Rpt. Govt. Porto Rico to Secretary of War, Washington, D. C., Appendix **LX** pp. 685–707, 1919. (Rev. Appl. Ent. ser. A. **9**: 332, 1919.)

A record of the occurrence of mosaic of sugar cane in Puerto Rico.

Carne, W[alter] M[illard]

Spotted wilt of tomatoes. W. Australia Dept. Agric. Leaflet **116**, 1923.

Popular.

Lithiasis and bitter pit of pears. Journ. Dept. Agric. W. Australia 2 Ser. **4**(2): 202–206, 1927.

Description of these two diseases before the cause was known.

Mosaic and leaf roll of potatoes. Journ. Dept. Agr. W. Australia 2 Ser. **4**(2): 322–329, 1927.

Bitter pit in apples: Some recent investigations. Journ. Australian Council Sci. & Indus. Res. **1**(6): 358–365, 1928.

Report of recent observations. This work was done before the cause was known.

A preliminary note on a theory as to the origin of bitter pit in apples. Journ. Dept. Agric. W. Australia 2 Ser. **4**(3): 382–385, 1927.

The author attributes the bitter pit of apples to excessive transpiration. He explains his conclusions, written before the cause was known.

-------------, **Pittman, H. A., & Elliot, H. G.**

Studies concerning the so-called bitter pit of applies in Australia, with special reference to the variety Cleopatra. Australia Council Sci. & Indus. Res. Bull. **41**, 88 p., 1929.

This is a preliminary report. It reviews the literature, describes the disease, and gives control measures. This paper was written before the true cause of the disease was known.

Carpenter, C[larence] W[illard]

The Río Grande lettuce disease. Phytopathology **6**: 303–305, 1916.

The first record of this disease.

Carrante, Vicenzo

La produzione della patate da semente e le malattie da virus. (Potato production by seed and the virus disease.) L'Italia Agricola **11**(4): 439–463, 1933.

A well illustrated popular paper giving good description.

Carroll, E.

On the disease in potatoes called curl. Irish Farmers' & Gard. Mag. **4**: 248–251, 1837.

Historical.

Carriére, E. A.

Revue Horticole **52**: 444, 1880.

Mention of *Pittosporum tobira variegata*.

Influence du greffon sur le sujet. (Influence of the graft upon the stock.) Rev. Hort. **59**: 58–59, 1887.

Mention of *Pittosporum tobira variegata, Ilex, Rhamnus, Acer pseudoplatanus* var. *euchlora.*

Resistance in sugar beet to curly-top. Phytopathology (Abstract) **16**(1): 87–88, 1926.

Carsner, Eubanks

Susceptibility of various plants to curly top of sugar beet. Phytopathology **9**(9): 413–421, 1919.

The author gives a list of susceptible plants obtained by experimental studies.

————, & **Stahl, C[owins] F[loyd]**

The relation of *Chenopodium murale* to curly-top of the sugar beet. Phytopathology (Abstract) **14**(1): 57, 1924.

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Progress report on curly-top of sugar beet. Phytopathology (Abstract) **14**(2): 122–123, 1924.

————, & ————

Studies on curly-top disease of the sugar beet. Journ. Agric. Res. **28**(4): 297–319, 1924. (Facts About Sugar, March 1925.)

Gives review of the literature, the distribution of the disease and the leafhopper. Discusses the importance of the disease, the incubation period in the insect, the relation of the number of insects to the disease, the effects of light and temperature, susceptibility, other hosts overwintering and methods. of control.

Spring infection of sugar beet leafhopper with curly-top virus. U. S. D. A. Official Rec. No. 34, 3 p. 1925.

A bean disease caused by the virus of sugar beet curly-top. Phytopathology (Abstract) **15**(11): 731, 1925.

Attenuation of the virus of sugar beet curly-top. Phytopathology **15**(12): 745–756, 1925.

Chenopodium murale, Rumex crispus and *Sualda moquini* are difficult to infect. The attenuation of the virus from these plants does not give immunity to beets.

Resistance in sugar beet to curly top. U. S. D. A. Circ. **388**, 7 p., 1926.

Based on the evidence reported the author hopes to find a resistant variety of beet to curly top.

Susceptibility of the bean to the virus of sugar-beet curly-top. Journ. Agric. Res. **33**(4) : 345–348, 1926.

Brief account on the susceptibility of bean to the virus of sugar-beet curly-top, transmitted by the leafhopper *Eutettix tenella* Baker. Description of symptoms and enumeration of susceptible varieties of beans.

———— **& Lackey, C[harles] F[ranklin]**

Further study on attenuation of the virus of sugar beet curly-top. Phytopathology (Abstract) **18**(11) : 951, 1928.

————, **&** ————

Mass action in relation to infection, with special reference to curly-top of sugar beet. Phytopathology (Abstract) **19**(12) : 1137, 1929.

————, **Abegg, F. A., Cormany, C. E., Elcock, H. A., Keller, W., Lowe, C. C., Owen, F. V., Park, D. A., Price, C., & Skuderna, A. W.**

Curly-top resistance in sugar beets and tests of the resistant variety U. S. No. 1. U. S. D. A., Tech. Bul. **360**, 68 p., 1933.

Gives the results of experimental work with this important variety.

Carter, Walter

Population of *Eutettix tenellus* Baker and the osmotic concentration of its hosts plants. Ecology **8** : 350–352, 1927.

The author does not discuss virus diseases, but this insect is of interest in connection with curly-top of sugar beet.

Extensions of the known range of *Eutettix tenellus* Baker and curly-top of sugar beets. Journ. Econ. Ent. **20** : 714–717, 1927.

A record of an outbreak of curly-top of sugar beet in Montana and an abundance of the insect vectors.

Ecological studies of curly-top of sugar beets. Phytopathology (Abstract) **17**(10) : 747, 1927.

A technic for use with homopterous vectors of plant diseases with special reference to sugar-beet leafhopper, *Eutettix tenellus.* Journ. Agric. Res. **34**(5)449–452, 1927.

A description of a device for artificial feeding of the insects.

An improvement in the technique for feeding homopterous insects. Phytopath. **18**(2): 246–247, 1928.

A very short paper in which the author describes the method.

Transmission of the virus of curly-top of sugar beet through different solutions. Phytopathology **18**(8): 675–679, 1928.

The author gives the results of experiments with leafhoppers as transmitting agents.

The purpose of predicting outbreaks of *Eutettix tenellus* Baker under present-day conditions. Journ. Econ. Ent. **22**(1): 154–158, 1929.

A study which is of value in connection with the study of the curly-top of sugar beets.

Seasonal and regional variations in curly-top of sugar beets. Science **63**(1625): 213–214, 1926.

Observations indicate "That the abundance or scarcity of beet leafhoppers and presumably also the climatic conditions of a given area rather than the severe outbreaks occurred simultaneously throughout the range of the insects at periodic intervals."

Susceptibility of the virus of sugar beet curly-top. Journ. Agric. Res. **33**(14): 345–348, 1926.

The author gives proof that a disease of the beans is caused by the same virus as that causing the curly-top of the sugar beet and that it is carried by the insect (*Eutettix tenella.*)

Curly-top problems from the pathological standpoint. Utah Agric. Expt. Sta. Misc. Publ. No. 3, 1927.

Ecological studies of curly-top of sugar beet. Phytopathology **19**(5): 467–477, 1929.

"The development of curly top appears to be more severe under conditions of high light intensity, temperature, and evaporation than under conditions where these factors are reduced in intensity. One experiment indicates that the conditions governing susceptibility to in fection are not the same as those conditioning the later development of the disease. Experiments on the control on external environment indicate that lampblack and zinc oxide when sprayed onto the leaves, interfered with the normal functions of the plant and did not favor the development of the disease. Hydrated lime reduced the severity of the disease but did not affect the normal beet."

Ecological studies of the beet leaf-hopper. U. S. Tech. Bull. **206**: 114 p., 1930.

This paper does not deal with any virus disease but is of interest because the insect is a carrier of the curly-top of the sugar beet.

Some phases of the sugar-beet leaf-hopper problem. Journ. Washington Acad. Sci. **20**: 153–155, 1930.

Comparison of tobacco dust with other forms of nicotine in control of yellow spots of pineapples. Journ. Ecom. Ent. **25**(5): 1031–1035, 1932.

Tobacco dust was superior to other nicotine preparations in the control of the vector (*Thrips tabaci*).

The pineapple mealybug (*Pseudococcus brevipes* (Ckl.) and wilt of pineapples. Phytopathology (Abstract) **22**(12): 996–997, 1932.

The spotting of pineapple leaves caused by *Pseudococcus brevipes* (Ckl.) the pineapple mealybug. Phytopathology (Abstract) **22**(12): 996, 1932.

The pineapple mealybug, *Pseudococcus brevipes* and wilt of pineapples. Phytopathology **23**(3) 207–242, 1933.

The author gives excellent description of this disease and the results of experimental work by which he demonstrated that the disease is carried by this insect There is no positive proof that this disease is due to a virus.

The spotting of pineapple leaves caused by *Pseudococcus brevipes* the pineapple mealy bug. Phytopathology **23**(3): 243–259, 1933.

This insect causes two types of spots and it is not known that either of them is due to a virus. The power to cause green spots is transmitted from mother to young but not all the young ones have the power to transmit the disease.

Casagrandi, O.

Virus filtrabili ed ultrafiltrabili (Tecnica e ricerche personnali). (Filterable and ultrafilterable viruses. Personal technique and researches). Bull. Atti. A. Acad. Med. Rome. **52**(9): 285–288; (10): 340–344, 1926.

Cation, Donald.

Three virus diseases of the peach in Michigan. Michigan Agric. Expt. Sta. Circ. Bull. **146**: 2 p., 1932.

A brief historical review of yellow and little peach and a description of a new virus disease to which he gives the name "red suture."

Cayley, Dorothy M.

"Breaking" in tulips. Gard. Chron. **83**(2164): 435–436, 1928. (Ann. Appl. Biol. **15**(4): 529–539, 1928.)

The author gives the results of experiment proving that the disease is infectious and transmissible.

Ecological studies of curly-top of sugar beets. Phytopathology **19**(5): 467–477, 1929.

A discussion of the environmental factors under which the symptoms are increased or decreased.

Ecological studies of the beet leafhopper (*Eutettix tenella*). U. S. D. A., Tech. Bull. **806**, 114 p., 1930.

This paper does not contain any data on virus diseases but is of interest because of the relation of the insect to the curly top of sugar beet.

"Breaking" in tulips. II. Ann. Appl. Biol. **19**(2): 153–172, 1932.

The disease is transmitted by grafting and by inserting plugs of diseased tissue into healthy bulbs. Experiments with filtered sap, have given negative results. Experiments of transmission to promote breaking have given negative results. The variety Keizerskroon is a true bicolor and the pattern is not of a virus.

Ceresa, G.

Control de la enfermedad del "Mosaico", (Mosaic disease control). Rev. Agric. Com. & Trab. Cuba **8**(1): 5–9, 1926.

Chapman, G[eorge] H[enry]

Investigation relating to mosaic disease. Massachusetts Agric. Expt. Sta. Ann. Rpt. **20**: 136–144. 1908.

Compares tomato and tobacco mosaic, describes the former, gives results of studies with fertilizers and on the catalase of the plant. Also discusses susceptibility.

Mosaic allied diseases, with especial reference to tomato and tobacco. Massachusetts Agric. Expt. Sta. Ann. Rpt. **25**: 94–104, 1913.

Tobacco mosaic causes losses of more than one million dollars Tomato mosaic in greenhouses only, and of little importance Disease is physiological and may be caused by injuries to roots, improper sterilization of the seedbeds, etc Not caused by mineral fertilizers. Infectious Not contagious

Effect of colored light on the mosaic disease of tobacco Science n s. **43**(1111) 537–538, 1916

Gives the results of experiments to determine the effects of colored lights on tobacco mosaic This is discussed more fully in Bull. 175 published in 1917

Mosaic desease of tobacco, Massachusetts Agric Expt Sta Bull **175** 75–117, 1917.

An extensive study giving a historical summary, a description of the disease, occurrence, economic importance, infectious nature, pathological anatomy of plant, methods of transmission, the effects of fertilizer and colored lights Also a study of the enzyme activity of the plants Believes the disease is due to a disturbance of the enzyme activities

Chapple, J.

A method of potato management for preventing the curl Path. and West of England Soc Papers **7** 350–351, 1795

Historical value

Chardon, Carlos E[ugenio]

Informe anual del Patologo Especial para el año fiscal de 1921–22 (Annual report of the Special Pathologist for the Fiscal year 1921 22) Ins Expt Sta Porto Rico Ann Rev. **1921–22** 67–74, 1922.

Resumen de la literatura del origen de las enfermedades del "Mosaico" en las plantas (Review of the literature about the origin of "Mosaico" diseases of the plants) Rev Agric. Puerto Rico **9**(4) 13–22, 1922.

A review of the literature and list of publications

———, & Veve, R[afael] A.

Sobre la transmisión del matizado de la caña por medio de insectos (About the transmission of sugar cane mosaic by means of insects) Memoirs Ass'n, Sugar Tech Porto Ricc **1**(1) 9–12, 1922 (Rev Agric Porto Rico **9**(2) 9–20.) 1922 Facts About Sugar **15**(14) 281–284, 1922 Louisiana Planter & Sugar Manuf **69**(19) 323–324, 1922

Give the results of experiments which proved that *Aphis maidis* is a carrier.

The transmission of sugar cane mosaic by *Aphis maides* under field conditions in Porto Rico. Phytopathology **13**(1): 24–29, 1923. (Rev. Appl. Mycol **2**: 390–391, 1923. Rev. Appl. Ent. ser. A. **12**(2): 40, 1924. Rev. Agric Com. & Trab. (Cuba **7**(2): 37–41, 1924.)

This paper gives the results of experiments which demonstrate that the disease is carried by *Aphis maides*. Also some grass host of the disease. The same discussion in the preceding article.

La relación de ciertas yerbas con el matizado de la caña de azúcar. (Relation of certain weeds with sugar cane mosaic.) Rev. Agric Puerto Rico **12**: 305–314, 1924. (Rev. Appl. Ent. ser. A **12**(2): 40, 1924.) Rev. Agric. Com. & Trab. (Cuba) **7**(2) · 37–41, 1924.)

A study of the disease with special reference to *Aphis maidis* and certain grass hosts.

La transmisión del mosaico. (Transmission of mosaic.) Sugar **25** · 477 478, 1924

Mosaic investigations at Central Cambalache. (Preliminary Report). Journ Dept. Agric. Porto Rico **8**(2): 27–39, 1924, (Int Sugar Journ **27**(324) 649–651, 1925. Rev. Appl. Mycol. **4** · 505 506, 1924. Rev Agric. Puerto Rico **13**. 205–218, 1924. Facts About Sugar **19** 569, 1924.)

"Mosaic" o matizado de la caña de azúcar. ("Mosaic" or mottling of sugar cane.) Rev Agric. Puerto Rico **14**: 188–197, 1925. (Rev. Appl. Mycol. **4**: 635, 1925.)

La revolución de las variedades de caña en Puerto Rico. (The varietal revolution of Sugar cane in Porto Rico.) Rev. Agric. Puerto Rico **18** 117–127, 1927. (Rev. Appl. Mycol, **6**: 581, 1927. Planter & Sugar Manuf. **78**(22): 429–430; (23): 451–453, 460, 1927. Journ Dept. Agric. Porto Rico **11**: 9–41, 1927.)

This paper includes a discussion of the relation of mosaic to the varietal revolution of sugar cane in Porto Rico.

The agricultural revolution in Porto Rico. Facts About Sugar **22**: 894–897, 1927.

Chatterju, N. C., et al

Investigations on the spike-disease of Sandal. I. Résumé of the observations made to date. II. Report of progress made during the quarter ending 30th June, 1931, Indian Inst. of Sci. Bangalore, 16 p., 1931.

A review of the history of the disease and a sketch of recent work.

Cheal W[illiam] F[rank]

Investigations of hop mosaic disease field. Ann. Appl. Biol **16**(2) : 230–235, 1929.

Proof that the disease is infectious and can be introduced by carrier plants.

Chevalier, Aug[ust]

Sus l'extension et la propagation de la maladie de la rosette d'Arachide au Senegal. Comp Rend. Acad. Sci. (Paris) **193** (22) : 1115–1117, 1931

The virus of the peanut rosette is transmitted by *Aphis laburni*. The disease also attacks the Sakhagayer, a peanut growing on fallow land. This appears earlier than the cultivated peanut and carries the disease from year to year.

Chiel, The

Stripe sick cane. South Africa Sugar Journ. **9** : 439–440, 1925.

The author believes that the stripe disease is a form of mosaic.

Christie, G[eorge] I[rving]

Report for 1921 of the Department of Botany Indiana Agric. Expt. Sta. Ann Rpt **1921** : 14–19, 1921.

Chu, H.

(The speciality of mosaic disease.) Ent. & Path. Hangchow, China **2**(12) : 219–240, 1934.

Church, Margaret B[rooks]

The relation of mosaic disease to pickling of cucumber. Phytopathology **11**(1) : 28–29, 1921.

A study of the effect of the disease on the pickling quality of the cucumber.

Ciferri, R[afael]

Measuring the intensity of discoloration of sugar cane leaves. Proc. Fourth Congr. Intern. Sec. Sugar Cane Technologists, 1932. (Facts About Sugar (Abstract) **27**(6) : 260, 1932.)

The author describes his procedure and observations with the Moll nephelo-absortimeter while measuring the intensity of light through

leaves of "Cristalina" variety of sugar cane which is susceptible to mosaic. The infected leaves showed that the opacity is about 27% greater than that of healthy foliage and practically constant.

Thickness of mottled and healthy sugar cane leaves. Proc. Fourth Intern. Congr. Soc. Sugar Cane Technologist, 1932. (Facts About Sugar (Abstract) **27**(6): 260, 1932.)

Based on 17,620 micrometric measurements with galvanometric control of the trickness of mottled and healthy leaves of sugar cane varieties susceptible to mosaic. He observed that the diseased leaves are slightly thicker than the healthy ones.

Cláusen,

Die Blattrollkrankheit der Kartoffel. (The leaf roll disease of potato.) Märkischer Landwirt. **3**: 503, 1922. (Landw. Wochenbl. Schlezw. Holst. **72**: 587, 1922.)

Clayton, E[dward] E[astman]

Effect of early spray and dust applications on later incidence of cucumber wilt and mosaic diseases. Phytopathology **17** (7): 473–481, 1927.

The most important vector is the striped beetle. Bordeaux and lead arsenate sprays led to a reduction in the mosaic due to control of insects. The spray treatments were better than the dust treatments.

Breeding for resistance to cucumber mosaic disease. Phytopathology (Abstract) **19**(1): 85–86, 1929.

A study of the mosaic disease of crucifers. Journ. Agric. Res. **40**(3): 263–270, 1930.

The mosaic of swede turnips (*Brassica napobrassica*) does not appear to be serious. It is carried by the cabbage aphid (*Brevicoryne brassicae*). Cauliflower and Brussel sprouts are slightly susceptible. Cabbage is highly resistant or immune. Chinese cabbage (*B. chinensis*), cultivated white (*B. alba*) and black mustard (*B. nigra*) and rape (*B. napus*) are susceptible. The symptoms vary on different hosts and are usually most severe at 65 to 75 degrees F.

Cucumber disease investigations on Long Island. New York (Geneva) Agric. Exp. Sta. Bull. **590**, 20 p., 1931.

Conclusions are given that the only way of controlling mosaic, the chief cause of the decline of cucumber in Long Island, is by developing resistant varieties.

Cleare, L[aurence] D[elaney] Jr.

Report of the Biological Division. British Guiana Dept. Agric. Ann Rpt. **1924** 65–68, 1926 (Rev. Appl. Ent. ser. A. **14**: 238, 1926)

Cleveland, C[larence] R[ugg]

The relation of insects to the transmission of potato leafroll and tomato mosaic in Indiana Indiana Agric. Expt Sta. Bull. **351**, 24 p, 1931

The author gives a relation and importance of insects as carriers of diseases, especially on tomato and potato He gives methods of control and spraying schedules

The relation to the transmission of potato leafroll and tomato mosaic in Indiana Indiana Agric Expt. Sta. Bull. **351**, 24 p., 1931

Considerations as to the different degrees of importance of the different insect vectors e g the aphid *Myzus persicae*, the leafhopper *Empoasca fabea*, the pink and green potato aphids *Macrosiphum solanifolii* (*M gei*) and the flea beetle *Epitrix cucumeris* in the spread of mosaic on potato. In regard to tomato mosaic *M persicae* is believed to be mainly responsible for transmission from tomato to tomato the potato leafhopper, *Empoasca fabea*, the onion thrips *Thrips tabaci* and the common red spider *Tetranychus telarius* are considered capable of transmitting tomato mosaic

Cleveland, L[emuel] R[oscoe]

Some problems that may be studied by oxygenation Science **63** 168–170, 1926

The author suggests the studying of a large number of diseases, including virus diseases by a method of oxygenation

Cleveringa, O. J.

Verschillende belangrijke ounten voor het pootgoedoraagstuk bij aardappelen, in her vijzonder ook de rol die de afdeel ingen, (del landbouwmaatsppijen) daarbij Kunnen vervullen. Tijdschr Plantenz **30**(2) 17–26, 1924.

Certified seed gave good yield the first year but there was a rapid decrease the following years as a result of infection by virus diseases.

Clinch, Phillis

Cytological studies of potato affected with certain virus diseases. Sci. Prov. Roy. Dublin Soc. **20**(15) · 143–172, 1932.

Detailed account of the author's cytological investigations of potato plants affected with certain virus diseases Those types considered were simple mosaic, crinkle, interveinal mosaic, aucuba mosaic, streak, and leafroll

Clinton, G[eorge] P[erkins]

Chlorosis troubles. Illinois Agric. Expt. Sta. Bull. **40**, p. 139, 1895.

Chlorosis troubles, aster, peach, raspberry yellows and tobacco calico. Connecticut Agric. Expt. Sta. Ann. Rpt. **1903**: 305, 341, 355, 363, 1903.

Gives record of mosaic disease on many plants.

Report of botanist. Connecticut Agr. Expt. Sta. Rept. **1905**: 270–273, 1906.

Description of a disease of onions called brittle on account of the brittleness of the leaves; although not described as a virus disease it appears as an early record of the disease which recently has been proved to be due to a virus and known as dwarf.

Lima bean chlorosis and tobacco calico. Connecticut Agric. Expt. Sta. Ann. Rpt. **1907**: 341, 362, 1907.

Gives record of mosaic disease in many plants.

Notes on fungus diseases etc. for 1908. Connecticut Agric. Expt. Sta. Ann. Rpt. **1908**: 857–858, 865–866, 872–979, 1909.

Muskmelon chlorosis and mosaic diseases on several plants. Peach yellows and so-called yellows.

Thirty-third and Fourth Reports of the Botanist. Connecticut Agric. Expt. Sta. (New Haven) Rpt. **33–34**: 735, 1910.

Gives record of mosaic disease in many plants.

Tobacco calico Connecticut Agric. Expt Sta. Bull. **166**: 10. 1913.

String leaf tobacco. Connecticut Agric. Expt. Sta. Ann. Rpt **1913**: 27, 1913.

Gives record of mosaic disease in many plants.

Chlorosis of plants with special reference to calico of tobacco. Connecticut Agric. Expt. Sta. Ann. Rpt. **1914**: 357–423, 1915.

Gives a discussion of types of chlorosis, nomenclature, host prevalence, distribution, review of literature and results of his own experiments.

Mosaic or white pickle. Connecticut Agric. Expt. Sta. Ann. Rpt. **1915**: 430–431, 1916.

A record. Also a record of chlorosis and crinkling of soy bean on page 446.

Notes on plant diseases of Connecticut. Connecticut Agric. Expt. Sta. Rept. **1915**(6) : 421–451, 1916.

Contains records.

New or unusual plant injuries and diseases found in Connecticut, 1916–19. Connecticut Agric. Expt. Sta. Bull. **222** : 397–482, 1920.

Records of chlorosis on *Celastrus scandens* and *Ribes vulgare.*

Peach "Yellow" Nature and cause of mosaic disease of plants. Connecticut Agric. Expt. Sta. Director's Rpt. **1924** : 207, 1925.

Very brief reference.

————————, **& Anderson, P. J.**

Tobacco diseases observed in 1926. Connecticut Agric. Expt. Sta. Tobacco. Sta. Bull. **8** : 55T–57T, 1927.

————————, **& McCormick, F[lorence A.]**

Tobacco mosaic. Connecticut Agric. Expt. Sta. Tobacco Sub-Sta. Bull. **10** : 75T–82T, 1928.

Cockerham, G.

Variations in the total nitrogen content of normal and leafroll potatoes. Proc. Leeds. Phil. & Lit. Soc. (Sci. Sect.) **2**(8) : 375–382, 1933.

Considerations of the pronounced disturbances in the metabolism of nitrogenous substances within the potato due to the presence of the leafroll virus. Discussion of results obtained with a great deal of tabulated data.

Coit, J. E.

Sun-blotch of the avocado, a serious physiological disease. California Avocado Assoc. Yearbook, p. 27–32, 1928.

This paper was written before it was demonstrated that the disease was due to a virus.

Colby, A. S., & Anderson, H. W.

Diseases of brambles in Illinois and their control. Illinois Agric. Expt. Sta. Circ. **305**, 1926.

Several virus diseases of brambles are described.

Coleman, Leslie C[harles]

Spike disease of sandal. Mysore State Dept. Agric. Mycol. ser. Bull. 3, 52 p., 1918.

After discussing the conditions under which the disease appeared the author concludes that it is a virus disease comparable to other virus diseases in behavior and that it is communicated by grafting and insects. The accumulation of starch in the leaves and the dying of root tips and haustoria are definite symptoms. This appears to be the first paper giving evidence that the disease is caused by a virus.

Transmission of sandal spike. Indian Forester **49**(1): 6–9, 1923.

Gives proof by means of grafting that this disease is due to a virus.

Colón, E[mundo] D[imas]

La enfermedad de las rayas amarillas. (Yellow stripe disease.) Porto Rico Ins. Expt. Sta. Circ. **14**: 3–6, 1918.

Popular account of this disease new to Porto Rico.

Yellow stripe of sugar cane. Porto Rico Ins. Expt. Sta. Ann. Rept. **1918–19**: 66–68. 1919.

The absorption spectrum of the chlorophyll in yellow striped sugar cane. Journ. Dept. Agric. Porto Rico **3**(4): 43–53, 1919.

These studies indicated that there is no decomposition of chlorophyll.

La enfermedad de las rayas amarillas. (Yellow stripe disease.) Sugar **21**: 52, 1919.

A brief popular discussion.

Trabajos de investigacion durante el año Fiscal 1919–20. Research work during the Fiscal year 1919–20. Rev. Agric. Puerto Rico **6**(3): 7–14, 1921.

A review of work done at the Insular Experiment Station of Puerto Rico.

Chemical changes in yellow striped sugar cane. Porto Rico Ins. Expt. Sta. Ann. Rpt. **1920–21**: 18–19, 1921.

Condit, I[ra] [Judson], & Horne, W[illiam] T[itus]

A mosaic of the fig in California. Phytopathology (Abstract) **23**(1): 7. 1933.

Account of a disease which appears to be a true mosaic of fig No insect vector of the disease has been detected Transmission is discussed

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A mosaic of the fig in California Phytopathology **23**(11) 887–896 1933

A more detailed account than the preceding abstract and well illustrated The authors discuss mosaic symptoms, variety susceptibility, vectors and field laboratory studies

Cook, Melville T[hurston]

Peach yellows and little peach Bot Gaz **72**(4) 250–255, 1921.

Gives the results of histological studies to determine the translocation of starch

The dissemination of peach yellows and little peach Phytopathology **12**(3) 140–141, 1922

Evidence that these diseases are transmitted in nursery stock

Estudio sobre la causa del matizado (Studies on the cause of mottling) Rev Agric Puerto Rico **13**(6) 373–376 1924. (Rev Appl Mycol **4** 378 1924)

A discussion of virus diseases with special reference to sugar cane mosaic.

The search for the cause of mosaic Facts About Sugar **19**(24): 570–571 1924

A popular paper

Present knowledge of mosaic disease Journ Dept Agric. Porto Rico **8**(2) 50 54 1925 (Int Sugar Journ **27**(324), 647–648, 1925)

Popular

Studies on the cytology of sugar cane mosaic Phytopathology (Abstract) **15**(1) 45, 1925

The control of sugar cane mosaic Facts About Sugar **20**(30): 67–68 1925

A popular discussion of the disease in Porto Rico

El dominio del matizado de la caña de azúcar (The control of sugar cane mosaic) Rev Agric Puerto Rico **14**(1): 7–9, 1925.

A popular discussions of the disease in Porto Rico

Histology and Cytology of sugar cane mosaic. Journ. Dept. Agric. Porto Rico **9**(1): 5–27, 1925. (Rev. Appl. Mycol. **5**: 387–388, 1925. Rev. Agric. Porto Rico **15**: 291–293, 1925.)

The author gives a review of the literature on this phase of the subject and the results of his own studies. The chlorosis areas are slightly thinner than the green areas. The green areas are the same as a healthy leaf of the same age. The intracellular bodies are present but difficult to find. Chloroplasts are smaller and fewer in chlorotic than in healthy cells.

Sugar production and cane diseases. Facts About Sugar **20** (45): 1068–1069, 1925. (Rev. Appl. Mycol. **5**: 187, 1925. Rev. Agric. Puerto Rico **15**: 273–276, 1925).

Popular.

El mosaico de la caña de azúcar en Puerto Rico. (Sugar cane mosaic in Porto Rico) Rev. Agric. Puerto Rico **17**(5): 6, 13, 1926. (Facts About Sugar **22**(9): 203, 1927. Rev. Appl. Mycol. **6**: 318–319, 1926.)

Popular.

Photo-synthesis of the sugar cane plant. Journ. Dept. Agric. Porto Rico 10(3-4): 239–242, 1926. (Rev. Appl. Mycol. **7**: 198, 1926.)

The author reviews the literature on this phase of the subject and makes comparative studies of sugar-cane mosaic with his previous studies on peach yellow and little peach. In the case of sugar cane the chlorotic areas do less photosynthetic work than the green areas but the translocation of carbohydrates is normal. In the case of peach yellows and little peach the translocation of carbohydrates is almost or completely inhibited.

Relationship of cane varieties to diseases. Journ. Dept. Agric. Porto Rico **9**(4): 277–282, 1926 (Rev. Appl. Mycol. **6**: 376, 1926.)

Contains a brief reference to mosaic.

The effect of mosaic on the content of plant cell. Journ. Dept. Agric. Porto Rico **10**(3–4): 229–238, 1926. (Rev. Appl. Mycol. **7**: 197, 1928.)

The author gives a review of the literature and the results of his own studies. The chlorotic areas are indistinct in the very young leaves. They became distinct with exposure to light. Later the chlorotic areas tend to become green. The chloroplasts are smaller and

fewer in number than in the green areas, but increase in size and number with age. The chlorotic areas increase in size as a result of cell growth and cell division and not by the encroachment of the virus on the surrounding cells. The nuclei are usually enlarged and deformed.

Some effect of mosaic on the contents of the cells. Phytopathology (Abstract) **17**(1): 57, 1927.

The effects of some mosaic diseases on the cell structure and the chloroplasts Phytopathology (Abstract) **20**(1): 142, 1930.

The effect of some mosaic diseases on cell structure and on the chloroplasts Journ. Dept. Agric. Porto Rico **14**(2): 69–101, 1930.

The author gives a review of the literature and the results of his own studies which are a continuation of previous studies in which he has used sugar cane, canna, tobacco, tomato and cowpea. The chlorotic areas are thinner than the green areas. The active agent inhibits the differentiation of the cell structure and of the chloroplasts. The earlier the attack, the greater the inhibition. The active agent does not penetrate the various parts of the leaf equally. The result is the chlorotic areas and variations in cell differentiation. There is no reason to believe that structure and development of chloroplasts are modified by the virus. It is a true case of inhibition. The development of cell structure is permanently checked but the chloroplasts of the chlorotic areas increase in size and number.

Distribución geografica de las enfermedades de la caña de azúcar. (Geographical distribution of sugar cane diseases. Rev. Agric. Puerto Rico **25**(5) 170–172, 1930. (Facts About Sugar **26**(1): 24–26, 1931.)

A chart is given with explanatory notes showing the distribution of sugar cane diseases throughout the world.

La situación actual en enfermedades de la caña de azúcar en Puerto Rico. (The present situation of sugar cane diseases in Porto Rico.) Rev. Agric. Puerto Rico **24**(12): 227–231, 1930.

Brief notes on sugar cane mosaic disease in Puerto Rico. Advocates Prof. Earle's recommendations in regard to control methods, i.g. "roguing" and the planting of immune or resistant varieties.

Enfermedades de la caña de azúcar en Puerto Rico. (Sugar cane diseases in Porto Rico.) Ins. Expt. Sta. Puerto Rico, Circ. **94**: 14–19, 1931.

Sugar-cane mosaic disease is the most important in Puerto Rico. In this paper the author discusses briefly the disease. Includes a short list of grasses which are also susceptible to sugar-cane mosaic.

Undescribe symptoms of mosaic in Porto Rico. Phytopathology (Abstract) **21**(1): 117, 1931.

New virus diseases in Porto Rico. Phytopathology (Abstract) **21**(1): 124, 1931.

Some unreported virus diseases are briefly described. 1. A mosaic of *Crotalaria striata;* 2. A rare mosaic of *Commelina longicaulis;* 3. A bunchy-top of *Carica Papaya;* 4. A variegation of *Abutilon hirtum;* 5. A variegation of several species of *Sida;* 6. A mottling of mulberry.

Some undescribed symptoms of mosaic in Porto Rican Tobacco. Journ. Dept. Agric. Porto Rico. **15**(2): 189–191, 1931.

The author gives the results of cross-inoculation experiments and of studies on the histology of leaves of various ages. The results of these later studies are, (1) When leaves are inoculated before the tissues are fully differentiated there is an inhibition of the development of cell structure and chloroplastic; (2) When chlorotic areas are formed on leaves with fully developed tissues there is no change in cell structure but the growth of the chloroplasts was inhibited; (3) That the enlargement of the mosaic areas on young leaves is due to cell division and growth and not to invasion of surrounding cells by the virus.

The leaf spots of tobacco; an after symptom of mosaic. Journ. Dept. Agric. Porto Rico. **15**(2): 183–187, 1931.

This appears to be the same as the spot described by Mayer in 1886 and which Iwanowoski and Polowzoff described later as "pockenkrankheit". The author believes these spots to be a late symptom of tobacco mosaic.

New virus diseases of plants in Porto Rico. Journ. Dept. Agric. Porto Rico, **15**(2): 193–195, 1931.

This paper records mosaic on *Adenoropium gossypifolium* and *Ipomoea nil.*

The effect of mosaic on cell structure and chloroplasts. Journ. Dept. Agric. Porto Rico. **15**(2): 177–181, 1931.

The author reports the result of studies of the effect of mosaic on the cell structure and chloroplasts of *Capsicum annuum, Crotalaria striata, Carica papaya, Eucharis amazonica* and a hybrid *Amaryllis.* The results confirm the author's previous opinion that the effect of many viruses is inhibitory.

Action inhibitrice du virus des mosiques sur l'évolution cellulaire. (Inhibitary action of mosaic virus in the cellular evolution.) Deuxiéme Congres international de Pathologie Comparée. p. 1–8, 1932.

This paper is a résumé of some of the work of the author published in "The Journal of the Department of Agriculture of Puerto Rico".

Virus diseases of plants. Sci. Monthly. **36**(4): 355–359, 1933.

Popular.

Cook, O[rator] F[uller]

Leaf-cut or tomatosis, a disorder of cotton seedling. U. S. D. A. Circ. **120**: 29–34, 1913.

This is a brief discussion of a disease which may be due to a virus.

Branchysm, a hereditary deformity of cotton and other plants. Journ. Agric. Res. **3**: 387–399, 1915.

It has not been proved that this is a virus disease but it has many of the characteristics of this group of plant diseases.

A disorder of cotton plants in China: club-leaf or cyrtosis. Journ. Heredity **11**: 99–110, 1920.

A description of the disease with evidence that it is due to a virus.

Malformation of cotton plants in Haiti. A new disease named smalling or stenosis, causing abnormal growth and sterility. Journ. Heredity **14**(7): 323–335, 1923.

The author describes a disease which he calls "smalling" or "stenosis". Certain characters resemble some of the virus diseases but it is neither contagious nor infectious.

Acromania or "crazy-top" a growth disorder of cotton. Journ. Agric. Res. **28**(8): 803, 1924.

It is known that this disease is caused by a virus. The author describes the symptoms of this disease and also of brachysm, tomosis, hybosis, cytosis and stenosis.

Cooley, L. M., & Rankin, W[illiam] H[oward]

Virus disease control experiments in black raspberry plantings in 1931. New York (Geneva) Agric. Expt. Sta. Bull. **601**: 3–6, 1931.

The results of the work. A brief report.

Mild streak of black raspberries. Phytopathology **22**(11): 905–910, 1932.

A description of a disease which is believed to be due to a virus. The cause has not been proved.

Coons, G[eorge] H[erbert]

The potato disease of Michigan. Michigan Agric. Expt. Sta. Bull. **66**, 31 p. 1914.

Popular paper describing diseases, including virus diseases.

Notes on plant diseases of Michigan. (Cucumber mosaic of white pickle.) Michigan Acad. Sci. **17**: 125–126, 1915.

Michigan potato diseases. Michigan Agric. Expt. Sta. Sp. Bull. **85**, 49 p., 1918.

Popular descriptions with illustration and distribution in Michigan are given about the following diseases: Curly-dwarf, leaf-roll, and mosaic. Methods of control are also given.

----------, & Kotila, J[ohn] E[rnest]

Mosaic in potato seed stock. Michigan Agric. Expt. Sta. Quart. Bull. 4(4): 135–138, 1922.

Popular.

Michigan potato diseases. Michigan Agric. Expt. Sta. Sp. Bull. **125**: 3–55, 1923.

Popular.

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Sugar beet strains resistant to leaf spot and curly top. U.S.D.A. Yearbook **1931**: 493–496, 1931.

Cooper, T[homas]

Mosaic disease of potato and tobacco. Kentucky Agric. Expt. Sta. Ann. Rpt. **1922**(1): 22–24, 37–38, 1922.

Cordingley, H., Grainger, J., Pearsall. W. H., & Wright, A.

The effect of mosaic disease upon certain metabolic products in the tobacco plant. Ann. Appl. Biol. **21**(1): 79–89, 1934.

Based on analysis, the authors found that a higher proportion of

nitrogen than of carbohydrates was present in the tobacco plant infected with mosaic disease. In diseased leaves protein breakdown is retarded and insoluble substances are less readily hydrolysed. The diseased leaves resemble older leaves in their metabolism.

Corneli, E.

Mal del mosaico su Patate. Ruggine su Grano in autunno. Mal del piombo su Peschi. (Mosaic disease of potatoes. Rust of wheat in Autumn. Silver leaf of peaches.) Riv. Pat. Veg. **23**(1–2): 51–52, 1933.

Brief notes on the occurrence of mosaic disease of potatoes in Perugia (Italy). Description of the disease.

Costa Lima, Angelo da

A propósito de una comunicacao do Dr. Puttemans sobre o mosaico da cana de assucar. (About letter from Dr. Puttemans related to sugar cane mosaic disease. Characas e Quitaes **34**: 30–42, 1926.

(Mosaic and thrips in Brazil) Bol. Agric. Ind. Comm. Brazil **2**: 38–41, 1926.

The writer believes that *Thrips minuta* var *Puttemansi* is the vector for mosaic of sugar cane.

Costantin, Julien [Noel]

La dégenérence des plantes cultivées et l'hérédité des caractéres acquis. (The degeneration of cultivated plants and the inheritance of acquired characteristics.) Ann. Soc. Nat. Bot. **4**: 267–297, 1922.

Cure d'altitude, (Altitude cure) Ann. Sci. Nat. Bot. ser. **10**, **6**: 271–283, 1924.

A propos des mutations de la pomme de terre. (Concerning mutations in the potato.) Ann. Sci. Nat. Bot. ser. X, **6**(5–6): 17–40, 1924.

Un nouvel essai sur les Pommes de terre montagnardes. (A new test on highland potatoes.) Ann. Sci. Nat. Bot. **8**(3–6): 355–362, 1926.

Un programme pour la lutte contre la dégénérescence des Pommes de terre. (A program for the fight against the degeneration of potato.) Ann. Sci. Nat. Bot. **9**(1): 281–284, 1927.

La cure d'altitude, son emploi et son efficacité en vegetalé. Essai d'une théorie de ce phénoméne. (Altitude is used successfully as a cure in plant pathology. Essay of theory on that phenomenon.) Ann. Sci. Nat. Bot. **9**(2): 299–369, 1927.

L'emploi des hybrides javanier de la canne a sucre contre le Sereh et mosaique. (The use of javanese sugar cane hybrids against sereh and mosaic diseases. Rev. Bot. Appl. Agric. Col. **9**(93): 229-240, 1929.

A review of the work on hybrids for the purpose of obtaining canes that are resistant to sereh and mosaic.

Les certificats phytopathologique de non-dégénérescence de la pomme de terre dans l'Amérique du Nord. (Phytopathological certificates attesting the freedom of potatoes from degeneration diseases in North America.) Comp. Rendus Acad. des Sci. **14**: 534-536, 1930

The author gives a brief note of the results obtained in United States and Canada in controlling potato virus diseases.

Influence de L' Altitude en Pathologie Végétale. (Influence of altitude in plant pathology.) Rev. Bot. Appl. & Agric. Trop. **10**(3): 851–860, 1930.

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Cultures experimentales de la pommes de terre dégénérées et saines en montagne et en plaine. (Experimental cultures of degerated and healthy potatoes in the mountain and in the plain. Acad. d'Agric. de France **16**(30): 1006–1010, 1930. (Compt. Rend. Acad. Sci. 191(22): 1038–1041, 1930.)

After experimentation the authors conclude that the favorable influence of the climate at high altitude can not operate unless rigid selection is practiced.

Accroisement de la résistance á la maladie par l'altitude. (Increase of resistance to the disease with the altitude.) Journ. Agric. Prac. **1**(39): 249–250, 1930.

Review of the observations of the behavior of different types of virus diseases and different host plants, to altitude.

Hérédité montagnarde acquise a la canne á sucre. Mountain heredity acquired by the sugar cane.) Comp. Rendus Acad. des Sci. **195**(5): 345–347, 1932.

This paper summarizes the studies on resistance to degeneration diseases acquired by mountain grown canes and calls attention to a correlation with morphological characters.

Importance de la mosaique de la canne au point de vue de la dégénérescence. (Importance of cane mosaic under the point of view of degeneration.) Comp Rend Sci (Paris) 194(19): 1614–1616, 1932.

Resistance to mosaic has been increased in Java by growing crops on mountain elevation

La mosaique de la canne á sucre. (Enseignements découlant de sa récente histoire.) (Sugar cane mosaic. What its recent history has taught us.) Agron Col. **21**(176): 41–51, 1932.

A general review of the subject. He believes that the reduction in mosaic in POJ varieties is due to this mountain origin.

Technique de la lutte contre les maladies de dégénérésence Perfectionnements importance pour l'agrononomical coloniale. Agric Prat Pays Chauds **3**(22) 241–250, (23) 321–336, 1932.

Diseased and healthy potatoes were planted Healthy potatoes gave higher yields than the diseased and the diseased potatoes in high altitudes gave higher yields than in the lower elevation .

Les curieux cas de variétés mosáiquées á cent pour cent. (Curious case of mosaic varieties 100%) Compt. Rend Acad. Agr. de France. **18**(34). 1149 1155, 1932.

Mention of sugar cane and potato mosaic

Role des montagnes en agriculture (The role of mountains in agriculture.) Rev Agric. France. **64**(12): 350–354, 1932.

Le secret de Java. (The Java secret) Compt. Rend. Acad. Sci. Paris **195**(19) · 741–744, 1932 .

In this article the author refers to the success obtained in Java breeding cane seedlings at high altitudes to prevent sereh disease. He claims it, as a prove to cure of the "altitude" for certain diseases.

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Experiences sur la cure en montagne de la pomme de terre. (Experiences on the mountain cure of the potato.) Ann. Sci. Natur. Bot. **14**(2): 327-341, 1932.

Variations de la virulence dans les dégénérescence de pomme de terre. (Variations in virulence in the degeneration of potatoes.) Compt. Rend. Acad. Sci. **196**(17): 1186–1189, 1933.

General account on virus diseases virulence especially on the potato.

L' immunité de la canne P. O. J. 2878 est-elle absolue? (Is the immunity of the cane P. O. J. 2878 absolute?) Compt. Rend. Acad. Sci. **196**(18): 1261–1264, 1933.

This article refers to the immunity of P. O. J. 2878 cane to sereh disease.

Résumé historique se rapportant á la genése des conceptions sur la dégénérescence des plantes cultivées. (Historical summary about the origin of the conception of the degeneracy of cultivated plants.) Compt. Rend. Acad. Sci. **196**(7): 449–451, 1933.

Cottier, W.

The transmission of virus disease of the potato by insects leaf-roll. New Zealand Journ. of Sci. and Tech. **13**(2): 85–95, 1932.

Experiments were conducted which demonstrated that leaf-roll of potato was transmitted by *Myzus persicae*, but not by *M. pseudosolani*, *Macrosiphum gei*, *Erythroneura Zealandica*, *Thrips tabaci* or *Melanphthalma gibbosa*. The shortest period of incubation in the plant was 29 and the longest 51 days.

Cotton, A[rthur] D[isbrowe]

Mosaic disease of potatoes. Journ. Ministry Agric. Great Britain **28**: 335–340, 1921.

Mosaic disease of potatoes. Gard. Chron. **70**: 131, 1921.

Popular.

The situation with regard to leaf-curl and mosaic in Britain. Roy. Hort. Soc. Inter. Potato Conf. Rpt. **1921**: 152–166, 1922.

Confirms work of Dutch and American students. Discusses susceptibility, environment and insects.

Potato leaf-curl demonstration. Journ. Ministry Agric. (Great Britain) 28(11): 1019–1021, 1922.

Diseases in cane. Further notes on the subject of cane diseases, mosaic Queensland Br. of Sugar Expt Sta. Director's Rpt 24th Ann. Rpt. p. 54–57, 1924

Sugar pests and diseases in the Mackey District Queensland Agric Journ. **21**(5): 363–368, 1924 (Rev. Appl Mycol. **3**: 686–687, 1924)

Reports sugar cane mosaic *Aphis maidis* not reported in list of sucking insects

Sugar cane diseases in the South Australian Sugar Journ. **16** 596–597, 604–605, 1924

The detection and control of lily diseases Lily Yearbook, Roy Hort Soc 1933 (Roy Hort Soc (London) p. 194–210, 1933)

The author describes mosaic disease which occurred in the following species of lilies *Lilium longiflorum*, *L. tigrinum*, *L. humboldtii*, and *L. croceum*, in these species the disease appears in a mild form, while in *L. auratum*, *L. speciosum* and *L. candidum* is much more severe *Aphis gossypii* the insect vector is abundant Control measures are given

Cottrell-Dormer, W.

Ilhau disease of sugar cane Australian Sugar Journ **16**: 838, 1925

Diseases of sugar cane Australian Sugar Journ **16** 543, 545–546, 1924.

Cane pests and diseases Queensland Agric Journ **22**(4): 275–277, 1924 (The Cent. Sugar Journ **16**(12) 833–835, 1924 Rev Appl. Mycol. **4**: 242, 1924)

Contains brief reference

Cane diseases and pests Queensland Agric Journ. **23**(1): 66–68, (4)271–272, 1925. (Rev. Appl. Mycol **4**: 267–268, 1925. Rev. Appl. Ento ser. A. **13**: 348 1925)

Brief reference on mosaic of sugar cane

Report to the Director of the Bureau of Sugar Experiment Stations on mosaic disease in Mackay Areas. Australian

Sugar Journ. **18**(1): 53–54, 1926. (Queensland Agric. Journ. **25**(4): 316–319, 1926. Rev. Appl. Mycol. **5**: 632, 1926.)

Mosaic has increased 300 per cent in two years. Recommends that corn and sorghum should not be grown near cane. Gives list of susceptibility hosts. Also recommends removal of *Panicum colonum*, *P. sanguinale* and *Setaria aurea*. *Aphis maidis* was plentiful on *P. colonum*.

Sugar cane pests in the district of Proserpine and Mackay. Queensland Agric. Journ. **25**(4): 312–319, 1926. (Rev. Appl. Ent. ser. A. **14**: 365–366, 1926)

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Fiji disease situation in Queensland. Queensland Agric. Journ. **28**(2): 125–141, 1927.

A general discussion of the disease with special reference to the situation in Queensland.

Cottrell, R[oy] H[udson]

Résumé of the relation of curly-top to commercial sugar beet production Utah Agric. Expt. Sta. Misc. Pub. No. **3**, 1927.

Cowdry, E[dmund] V[icent]

The nature and significance of cellular inclusion bodies in diseases due to filterable viruses. Journ. Bact. **13**(1): 20–21, 1927.

The micro-chemistry of nuclear inclusions in virus diseases. Sci. **68**: 40–41, 1928.

This paper has reference to virus diseases of animals but the method is of some interest to plant pathologists.

Cowgill, H[orace] B[ranson]

Report of the Plant Breeder. Porto Rico Ins. Expt. Sta. Ann Rpt. 1917–1918, p. 78–104, 1918.

Crawford, R[aymond] F[rank]

Over-wintering of mosaic on species of *Physalis*. Phytopathology (Abstract) **11**(1): 47, 1921.

Crawley, J[osiah] T[homas]

Control of the mosaic disease in Cuba. Facts About Sugar **22**: 554–555, 1927. (Rev. Appl. Mycol. **6**: 752, 1927.)

Gives results of roguing and seed selection.

Cross, W[illiam] E[rnest]

The Kavangerie cane Louisiana Planter & Sugar Manuf. **63**: 397–399, 1919.

Kavangerie proved to be immune The author also gives a discussion of its desirable and undesirable qualities

Las posibilidades de las cañas de Java en Louisiana. (The possibilities of the Java canes in Louisiana.) Rev. Indus. Agric Tucumán **11** 118–121, 1921

La Estación Experimental Agrícola de Tucumán. Su contribución a la Industria Azucarera de Puerto Rico) The Agricultural Experiment Station at Tucumán. Its contribution to the Sugar Industry of Porto Rico) Rev. Indus. Agric. Tucumán **13**(11–12) 207–211, 1923.

A controversy.

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La enfermedad del mosaico en Luisiana. (The mosaic disease in Louisiana) La Industria Azucarera Argentina **30**(376): 975–979, 1924

Cañas resistentes al mosaico en Tucumán. (Canes resistant to mosaic at Tucumán.) Industria Azucarera, Argentina **30** (370) · 660–661, 1924 (Louisiana Planter & Sugar Manuf. **73**: 468–469, 1924 Facts About Sugar **19**(11): 250–251, 1924.) Int Sugar Journ **27** · 551, 1925)

Popular. Deterioration of certain varieties believed to be due to mosaic Controversy

La importancia de la enfermedad del mosaico en Louisiana y las posibilidades de éxito de las "Cañas de Java" en ese país. (The importance of mosaic disease in Louisiana and the possibilities of success of the "Java canes" in that country.) Rev. Indus Agric. Tucumán **15**(1–2): 22–28, 1924. (Rev. Appl. Mycol. **4**: 123–124, 1925.)

A very general discussion of conditions in Louisiana.

The problem of sugar cane yield in Louisiana. Facts About Sugar **18**: 442–443; **19**. 181–185, 442, 1924.

A comparison of mosaic conditions in Louisiana and Tucumán.

El mosaico de la caña en Cuba. (Sugar cane mosaic in Cuba.) Rev. Agric. Com. & Trab. Cuba **7**(4): 9–10, 1924.

Popular.

The problem of disease and other sugar cane yield factors in Louisiana. Facts About Sugar **18**: 442–443, 1924.

Contains a brief note on mosaic.

Present needs in cane disease control. A rejoinder to Mr. A. H. Lee. Int. Sugar Journ. **27**: 26–31, 1925.

Enfermedades de la caña de azúcar en Tucumán. (Sugar cane diseases in Tucumán.) Sugar **27**(2): 103–104, 1925.

La importación de la caña Kavangire en Puerto Rico. (Kavangire cane importation into Porto Rico.) El Mundo Azucarero **14**(5): 145–149, 1926. (Planter & Sugar Manuf. **77**: 327-330, 1926.)

Controversial.

The P.O.J.-979 variety in Tucumán. The Planter & Sugar Manuf. **78**(1): 8, 1927.

The P. O. J canes in Louisiana. Facts About Sugar **22**: 1230–1231, 1235, 1927.

Cruz, Francisco B., & Bruner, S[tephen] C[ole]

Una visita de inspección a la Zona de tabaco en Cabaiguan. (An inspection of the tobacco region of Cabaiguan.) Rev. Agric. Comercio y Trab. Cuba **13**(10): 34–38, 1931.

A variety known as Puerto Rico which is probably *Nicotiana lanceolata* is very susceptible to mosaic. A small planting of *N. havanensis* was almost free from the disease.

Cunningham, G[ilbert] C[ameron]

Report of the Dominion Field Laboratory of Plant Pathology, Fredericton, N. B. Canada Expt. Farms. Div. Bot. Interim Rpt. **1921**: 57–67, 1921.

Report of Dominion Field Laboratory of Plant Pathology, Fredericton, N. B. Canada Expt. Farms. Div. Bot. Interim Rpt. **1921–22**: 23–30, 1922.

Curtiss, C[harles] F[ranklin]

Plant Pathology studies and Entomology work in Iowa Agricultural Experiment Station. Iowa Agric. Expt. Sta. Ann. Rpt. **1922**: 24–35, 39–43, 1922.

Mosaic diseases of cucumber and other plants. Iowa Agric. Expt. Sta. Ann. Rpt. **1923**: 39–40, 1923.

First record for Iowa of several plants affected with mosaic diseases.

Curzi, M[ario]

Malattie del pesco caratterizzate de filliscosi ("Phony disease" e "malattie del pennacchio") Boll. Staz. Patol. Veget.) Firenze **11**(3): 221–243, 1931

Su una clorosi maculata della rosa. (A chlorotic spot of rose.) Bull. R. Staz. Patol. Veg. **12**(4): 365–376, 1932.

Description of a chlorosis on roses. The disease is supposed to be due to the varietal sensibility to soil alkalinity.

Cuthbertson, D[avid] C[unninghame]

The relation of leaf and other diseases of the potato to the crop. Journ. Roy. Hort. Soc. **50**(1): 21–27, 1925.

Cutler, G[arner] H[omer,] & Sandford, G[uthierie] B[rown]

Potato Diseases. Alberta Univ. Col. Agric. Field Husb. Circ. **7**, 23 p., 1921.

Dade, H. A.

Cassava mosaic. Gold Coast Dept. of Agric. Year book 1930. Bull. **23**: 245–247, 1931.

The disease was observed on *Manihot apii* in 1926. It is spreading rapidly and the outlook is serious.

Dafert, F[ranz] W[ilhelm]

Bercht uber staatliche Massnahmen anlasslich des Anftretens und der Verbreitung der Blattrollkrankheit der Kartoffel in den Jahren 1908, bis 1910. (Mitteilugen des Komitees zum Studium der Blattroll-krankheit der Kartoffel, No. 1.) Zeitschrift fur das Land-wirtschaftlich Versuchsweseen in Oesierreich. Jahrg. **14**(5): 757–758, 1911.

Dale, H. H.

Introducing a discussion on the biological nature of the viruses. Brit. Ass'n. Adv. Sci. Centenary Meeting, London, Section 1, Physiology, 10 p., 1931. (Nature **128**(3232): 599–602, 1931. Agric. & Live Stock, India 2(1): 66–73, 1932.)

This paper is devoted to an effort to define virus.

Damf. A[lfonse]

Bibliografía de los principales trabajos relativos al mosaico de la caña de azúcar que se han publicado a partir del descubri miento de la enfermedad hasta el año 1929. (Bibliography of the leading articles related to sugar cane mosaic published from the discovery of the disease to the year 1929.) Boletín Mensual (Mexico) Oficina Federal para la Defensa Agrícola **3**(5–8): 186–236, 1929.

Dana, B[liss] F.

Mosaic and related diseases of potato and other crops. Washington Agric. Expt. Sta. Bull. **208**: 33–34, 1926.

Brief notes on experimental work conducted during the year in regard to virus diseases.

Diseases of vegetable and field crops (other than cereals) in the United States in 1928. U.S.D.A. Plant Disease Reporter Suppl. **68**: 15–109, 1929.

Mention of mosaic and curly-top of muskmelon, pumpkin, squash, and watermelon, ringspot of muskmelon, and yellows of lettuce.

Some experiments with mechanical transmission of the curly top virus. Phytopathology (Abstract) **22**(12): 997–998, 1932.

The author used Seín's method with varying results.

Curly top of vegetable investigations. Oregon State Hort. Soc. Ann. Rpt. **24**: 81–84, 1932.

A summary of our knowledge of the virus diseases of sugar beets, tomatoes, beans, pumpkins and squashes.

The curly-top disease of vegetables in the Pacific Northwest. Oregon Agric. Exp. Sta. Circ. Inf. **67**, 4 p., 1932.

————, & McWhorter, F. P.

Mosaic disease of horse-radish. Phytopathology (Abstract) **22** (12): 1000–1001, 1932.

Reports this disease which causes a dwarfing and yellowing.

Daniel, L.

Recherches sur la greffe des *Solanum*. (Researches on the grafting of the Solanum.) Comp. Rendus Acad. Sci. p., 1075, Nov. 29, 1920.

Darlington, H[aywars] R[adcliffe]

Yellow stripe of daffodils. Journ. Roy. Soc. (London.) **34**: 161–166, 1908.

Darnell-Smith, G[eorge] P[ercy]

"Bunchy top" in banana. Agric. Gaz. New South Wales **31**: 583–584, 1920.

Gives description of the disease and recommends the destroying of the diseased plants. Reports the isolation of bacteria and a *Fusarium*.

Bunchy top in bananas. Trop. Agric. (Ceylon) **55**(6): 380–381, 1920.

Suspicion of the occurrence of bunchy top on bananas, and recommendations are made regarding measures of control.

Bunchy top in bananas. Agric. Gaz. N. S. Wales **34**(12): 846, 1923.)

A brief note written before the cause was known.

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Banana bunchy-top disease. Queensland Agricultural Journ. **19**: 33, 1923.

Bunchy top disease in bananas. Queensland Agric. Journ. **21**(3): 169–179, 1924.

A discussion of symptoms and possible causes.

Dastur, J[ehangir] F[ardunji]

The mosaic disease of sugar cane in India. Agric. Journ. of India. **18**(5): 505–509. (Rev. Appl. Ent. ser. A. **11**: 543, 1923.)

A record of resistant varieties.

A mosaic-like disease of sugar cane in the central provinces in 1926. Agric. Journ. of India. **21**(6): 429–432. (Rev. Appl. Ent. ser. A. **15**: 127. Rev. Appl. Mycol. **6**: 186, 1926.)

Report of a disease different from but similar to mosaic.

Sugar cane mosaic. Fourth Congress Intern. Soc. Sugar Cane Technologists Puerto Rico, 1932, Bull. **24**, 4 p., 1933.

General account of sugar-cane mosaic disease as to its history, nature and behavior.

Davidson, W. D.

A review of literature dealing with the degeneration of varieties of the potato. Econ. Prov. Roy. Dublin Soc. **2**(21–22): 331–389, 1928.

The rejuvenation of the champion potato. Econ. Prov. Roy. Dublin Soc. **2**(21): 319–330, 1928.

Davis, Everett F[ogg]

Some chemical and physiological studies on the nature and transmission of "infectious chlorosis" in variegated plants. Ann. Missouri Bot. Garden **16**(2): 145–213, 1929.

The author gives the results of extensive studies on *Euonymous* and *Abutilon*. He could not confirm the studies of Baur concerning the effects of light.

Davis, E. W.

Notes on collection of the sugar beet leafhopper showing the extension of its known range into British Colombia and to the coast in Washington and Oregon (*Eutettix tenella.*) Journ. Econ Ent. **20**: 581–586, 1927.

This paper gives some data on the range of this insect which is the carrier of the virus of the curly-top of sugar beet.

Davis, J[ohn] J[une]

Biological studies on three species of Aphididae. U. S. Dept. Agric. Bur. Ent. Tech. ser. Bull. **12**: 123–168, 1909.

Virus and life. Nature **125**(3149): 351, 1930.

A controversial note.

Davis, R[obert] L[esley]

Java-Barbados hybrids in Porto Rico. Planter & Sugar Mafg. **83**(5)83–85, **100**(6): 103–104; (7): 123–125, 1929. (Rev. Appl. Mycol. **9**(2): 132, (1930).

Mayagüez 3, 7 and 42—Three cane varieties immune to mosaic. Porto Rico Agric. Expt. Sta. Agric. Notes No. **52**, 2 p. (Mimeograph.) 1930.

The three varieties Mayagüez 3, 7 and 42 produced from crossing POJ–2725 and SC–12(4) appeared to be resistant to mosaic.

Report of the Plant Breeder. Porto Rico Agric. Expt. Sta. Rpt. **1931**: 13–22, 1932.

Includes a report on some sugar canes commercially resistant to mosaic.

Mayagüez 28, 49 and 63, three sugar cane varieties commercially resistant to mosaic. Agric. Notes, Porto Rico Agric. Expt. Sta. Mayagüez **61**, 6 p., 1932.

A report on the behavior of these and other varieties.

Sugar cane crosses with Kassoer selfs. Trans. Fourth Intern. Soc. Sugar Cane Tech. 1932. (Facts About Sugar (Abstract.) **27**(5): 218, 1932.

Tests with crosses of Kassoer as to susceptibility to mosaic disease of sugar cane.

Sugar cane seedling mosaic elimination. Trans. Fourth Congr. Intern. Soc. Sugar Cane Tech. 1932. (Facts About Sugar (Abstract) **27**(5): 219, 1932.

Experiments to determine the optimum spacing and planting methods for obtaining data on the reaction of sugar-cane seedling to mosaic. Under Mayagüez (Puerto Rico) conditions, it was found that mosaic will spread in 8 months for a distance of 50 feet along a single row of a susceptible variety.

Report of plant breeder. Porto Rico Agric. Expt. Sta. Ann. Rpt. **1932**: 11–17, 1933.

Report of the work done during the year with mosaic-resistant seedlings.

Davis, W[illiam] H[arold]

Chlorotic corn. Proc. Iowa Acad. Sci. **24**: 459–460, 1917.

Decoux, L.

La frisolée de la betterave sucriere. (The curling of the sugar beet.) La Sucriere Belge **44**: 177–185, 1924.

A description of the symptoms of the disease and a discussion of quarantines.

Deerr, Noel

The yellow stripe cane disease. Facts About Sugar **10**(10): 190–191; (11): 210–211: (12): 232–233, 1920.

Deighton, F. C.

Report of the Mycological Section. Ann. Rpt. Lands and Forests Dept. Sierra Leone for the **1928**: 14–19, 1929. (Rev. Appl. Mycol. **9**(1): 18–20, 1930.)

Contains reference to mosaic of *Manihot glaziovii* and rosette of peanuts.

Mycological work. Sierra Leona Dept. Agric. Ann. Rpt. **1931**: 20–25, 1932.

Report on virus disease of cassava, *Lochera rosea* and *Sesamum radiatum.*

Delacroix, Edward G[eorges]

La Vouille Blanche du Tabac et la nielle ou maladie de la mosaique. (The "Vouille Blanche" of tobacco and the "Nielle" or mosaic disease.) Compt. Rendue 140: 678–680, 1905. (Rev. Zeithschrf. f. Pflanzenkh, **16**: 239, 1906.)

The disease "la nielle" reported by Prillieux and Delacroix 1894, was not true mosaic but a bacterial disease (*Vouille blanche*). Believes the "pockenkrankheit" of Iwanowski and "spotting" of Sturgis may be the same as *Vouille blanche.*

Recherches sur quelques maladies des Tabac en France. (Investigations of some tobacco diseases in France.) Ann. Inst. Nat. Agron. Paris. 2 Ser., **5**: 92, 1905. (Rev. Centr. Bakt. **20**: 193, 1905.)

De Long, D[wight] M[oore]

The occurrence of the beet leafhopper, *Eutettix tenella* Baker, in the Eastern U. S. Journ. Econ. Ent. **18**: 637–638, 1925.

An entomological record.

Delplace, E.

Essais de sélection en vue de parer la dégénérescence des pommes de terre faits en Loir-et-Cher de 1924 á 1928. (Tests of selection made in Loir-et-Cher in 1924 to 1928 with the view to guard against the potato degeneration.) Bull. Mens. Soc. Nat. Hort. France **5**(2): 287–289, 1929.

A popular paper suggesting methods of control.

Demarre, J. B.

Progress of pecan rosette control. Proc. 27th. Ann. Convent. Georgia–Florida Pecan Growers' Assoc. p. 38, 40, 42–43, 45, 1933. (Chem. Abstract **27**(22): 5880, 1933.

The author reports his success controlling pecan rosette with applications of zinc sulphate to the soil or placed in holes in the trunks of the trees.

Detmers, F[rederika]

Diseases of the blackberry and raspberry. Ohio Agric. Expt. Sta. Rpt. **4**: 128–129, 1891.

Diseases of blackberry and raspberry. Conn. Agric. Expt. Sta. Rpt. **1903**: 4–5, 1903.

Dey P[romode] K[umar]

A note on the control of sugar cane mosaic in the eastern districts. Bull. Dept. Agric. U. Prov. Agric. & Ondh. Bull. **46**: 7, 1929.

Dickson, B[ertram] T[homas]

Some plant diseases in the greenhouse. Quebec. Soc. Protec. of Plants. Ann. Rpt. **12**: 46–48, 1920.

A mosaic-like disease of *Cineraria*. Quebec Soc. Prot. of Plants. Ann. Rpt. 46–47, 1920.

Diseases of the potato: mosaic and mosaic dwarf. Sci. Agric. **2**: 93–96, 1921.

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Studies on mosaic. Phytopathology (Abstract) **11**(4): 202, 1921.

Plant diseases of 1920–21. Quebec Soc. Prot. of Plants. Ann. Rpt. **13**: 66–67, 1921.

Studies concerning mosaic diseases. Mc Donald College (Quebec) Tech. Bull. **2**, 125 p., 1922.

A very lengthy discussion giving symptoms of several mosaic diseases, histological studies, effects of light and methods of transmission.

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Further studies on mosaic. Phytopathology (Abstract) **12**(1): 42, 1922.

Plant diseases of 1921 in Quebec. Quebec Soc. Prot. Plant, Ann. Rept. (1921–22) **14**: 52–58, 1922.

Further studies on mosaic. Phytopathology (Abstract) 12: 16, 1922.

Further studies on mosaic 1. Phytopathology (Abstract) 12: 42, 1922.

Raspberry mosaic and curl. Sci. Agric. **3**(9): 308–310, 1923.

Gives brief history, symptoms, susceptibility and insect transmission.

Temperature studies in mosaic disease. Phytopathology (Abstract) **13**(1): 42, 1923.

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Temperature studies in mosaic disease. Phytopathology (Abstract) **13**(1): 42, 1923.

Studies in disease susceptibility. (Tobacco mosaic) Quebec Soc. Prot. Plant. Ann. Rpt. **1922–1923**: 15–60, 1923. (Sci. Agric. **3**: 307, 1923.)

Mosaic studies IV. Phytopathology (Abstract.) **14**(7): 346, 1924.

Tobacco and tomato mosaic. (1) Longevity of the virus of tobacco mosaic. Science **62**(1609): 298, 1925.

The juice from a mosaic tobacco plant kept in a sealed bottle for 5 years retained its vitality. The symptoms of tomato streak or stripe resulted from an inoculation with a mixture of potato and tomato mosaic juices.

Mosaic of rhubarb. Quebec Soc. Prot. Plants. Ann. Rpt. 1924–25. **17**: 36–37, 1925.

A record of mottling and dwarfing Inoculation experiments gave negative results.

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Inloed van den rootijd van aardappels op het optreden van degeneratis-ziekten in den natelted (Influence of potato harvest time on the occurrence of degeneration diseases in the progeny.) Landb. Tijdschr. **36**: 209–223, 1924.

A discussion of the susceptibility with reference to races and environments.

Dix, W[alter]

(Leafroll of potato.) Fuhling's Landw. Ztg. **62**(6): 214–222, 1913.

Dobroscky, I[rene] D[orothy]

Is the aster yellows virus detectable in its insect vector? Phytopathology **19**(11): 1009–1015, 1929.

This paper gives a record of studies in which the results were negative.

Cranberry false–blossom disease spread by a leafhopper. Science **70**(1826): 635, 1929.

Studies over a period of three years show that *Euscelis striatulus* is able to transmit the virus.

Morphological and cytological studies on the salivary glands and alimentary tract of *Cicadula sexnotata* (Fallen) the carrier of aster yellows virus. Contrib. Boyc. Thompson Inst. **3**(1): 39–58, 1931.

Studies on cranberry false blossom diseases and its insect vectors. Contr. Boyce Thompson Inst. **3**(1): 59–83, 1931.

A study of the salivary glands and alimentary canal did not show any difference between healthy and disease carrying insects.

Dobrosky, I. B.

Insect studies in relation to cranberry false blossom disease. Amer. Canberry Growers' Ass'n. Prot. Ann. Meetg. **58**: 6–7, 10–11, 1928.

Popular.

Dobrosky, T. L.

(Non parasitic diseases of the potato) Morbi Plantarum Leningrad **16**(2): 121–135, 1927.

Doby, G[éza] K[arl] von

Biochemische untersuchungen uber die Blattrollkrankheit der Kartoffel. (Biological studies on potato leafroll disease.) Zeitsch. fur Pflanzenk, **20**: 401–403, **21**(½): 10–17, (16): 321–336; **22**(4): 204–211; (7): 401, 403, 1912.

Die Amylase bei den gesunden und bei den von der Blattrollkrankheit befallenen Kartoffelknollen. Kiserlctügyi Közlemenyek **19**: 956–968, 1915.

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Biochemische Untersuchungen über die Blattrollkrankheit der Kartoffel. V. Die Amylase blattrollkranker Knollen. (Biochemical investigations on the leaf-roll disease of potato. V. The amylase in leaf roll diseased tubers.) Zeitschr. Pflanzen krankh. **25**: 4–16, 1915.

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Menace of streak disease. South African Sugar Journal. **9**: 549, 1924.

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A comparative study of streak diseased and healthy cane. The author gives the result of experiments for the control of insects and the use of fertilizer for the control of the disease.

Memorandum on methods of controlling streak diseases. South Afr. Sugar Journ. **9**(5): 337, 1925.

Streak diseases in Mauritius. Disease Proved Similar to Natal. South Afr. Sugar Journ. **9**: 583, 1925.

Treatment of streak disease. South Afr. Sugar Journ. **9**(9): 593–599, 1925.

Acquired Resistance of POJ–213 to mosaic. South Afr. Sugar Journ. **12**(10): 627–629, 1928.

Fongaat group members visit the Experiment Station. Afr. Sugar Journ. **14**(4): 265, 267, 269, 1930.

Streak disease of sugar-cane immunity in POJ–2714 and POJ–2725.

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Experiments to test the effects of streak disease of Uba cane. South Afr Sugar Journ. 16(4) 231–233, 1932

Description of experiments and results obtained.

The origin of mosaic disease South African Sugar Journ 16(11) 617, 619, 1932.

The information given in this article is the result of data gathered by the author while visiting Puerto Rico to attend the International Congress of the Association of the Sugar Cane Technologists held on February, 1932 He refers here to the mosaic of sugar cane in Puerto Rico

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Effect of streak disease on Uba cane South African Sugar Tech Ass'n Vol 8, 1934

Popular notes in regard to spread of the disease Recommends to plant Co 281, P O J 2878, 2727 and 2714 canes to replace Uba on account of their resistance to streak.

Dodge, B[ernard] O[gilvie]

Notes on cucurbit mosaic Phytopathology (Abstract) 12 42–43, 1922

Doolittle, S[ears] P[olydore]

A new infectious mosaic disease of cucumber Phytopathology, (Abstract) 6(2) 145 147, 1916

Gives a description and the results of successive inoculation experiments

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Further notes on cucumber mosaic disease Phytopathology (Abstract) 8(2) 77-78, 1918

Seed transmission of cucurbit mosaic by the wild cucumber. Phytopathology (Abstract) 9(8). 326–327, 1919

Thirteen out of 110 plants grown from seed of wild cucumber (*Micrampelis lobata*) were diseased.

The mosaic disease of cucurbit. U. S. D A. Dept Bull 879: 69 p., 1920

Gives symptoms, pathological anatomy, history, nature, methods of transmission, overwintering and other valuable data.

The relation of wild host plants to the overwintering of cucurbit mosaic. Phytopathology (Abstract) 11(1): 46–47, 1921.

————————, & **Walker, M[arion] N[ewman]**
Notes on cucurbit mosaic. Phytopathology (Abstract) **12**(1): 42–43, 1922.

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Intracellular bodies in the phloem tissue of certain plants and their bearing on the mosaic problem Phytopathology, **13** (7) 326–329, 1923

This paper gives the results of studies on the phloem tissue of mosaic and healthy plants The authors describe protozoa-like bodies such as were described by Strasburger for *Robinia pseudacacia*

————————, & **Walker, M[arion] N[ewman]**
Cross inoculation studies with cucurbit mosaic Science n s **57** (1477) 477 1923

This paper gives the results of cross inoculation studies

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The mosaic disease of melons and cucumber Iowa State Hort. Soc Rpt **57** 393 396 1923.

Popular

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Experiments of the control of cucurbit mosaic Phytopathology (Abstract) **14**(1) 56, 1924

Control of the cucurbit mosaic in the greenhouse U S D A Circ **321**, 5 p 1924

This paper gives general discussion of the disease with special attention to other host plants which carry the virus over winter.

————————, & **Walker, M[arion] N[ewman]**
Further studies on the overwintering and dissemination of cucurbit mosaic Journ Agric Res **31**(1) · 1–55, 1925.

A very extensive paper giving results of cross inoculations and the study of transmission by insect vectors Recommends removal of host plants in which the disease passes the winter.

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The mosaic in the garden pea and other legumes Phytopathology **15**(12) 763–771, 1925

The disease occurs on *Pisum sativum* and *Lathyrus odoratus*. It can be transferred to *Trifolium pratenses* in which it probably passes the winter.

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Control of cucumber mosaic by eradication of wild host plants. U. S. D. A. Bull. **1461**. 14 p, 1926.

This paper gives the results of a number of experiments on methods of control, including studies of the disease on other plants and also studies on transmission by insects.

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Investigations of cucumber mosaic. Canner **63**(18): 25–27; (19): 21–22, 1926.

Popular.

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Aphis transmission of cucumber mosaic Phytopathology (Abstract) **18**(1): 143, 1928.

Soil transmission of tobacco mosaic and streak in the greenhouse Phytopathology (Abstract) **18**(1): 155, 1928.

Greenhouse mosaic control. Wisconsin Hort. **20**: 61–62, 1929.

Popular.

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Investigation of tomato streak. Phytopathology (Abstract) **20**(1): 134, 1930.

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The occurrence of the Australian spotted wilt of tomatoes in Wisconsin. Phytopathology (Abstract) **21**(1): 106, 1931.

A virus disease appeared in Wisconsin similar to spotted wilt from Australia. It is readily transmissible to tomato by artificial inoculation.

Commelina nudiflora, a monocotyledonous host of celery mosaic. Phytopathology (Abstract) **21**(1): 114, 1931

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Commelina rudiflora, a monocotyledonous host of celery mosaic. in Florida. Phytopathology **24**(1): 48–61, 1934.

General discussion of the disease which has been observed during the past four years in Florida. The disease may be transmitted mechanically and by *Aphis gossypii*. Hosts are discussed. The virus does not appear to persist in the soil nor in the seed. Eradication of *Commeline nudiflora* is recommended as control for celery mosaic under Florida conditions.

Dorst, J[acobus] C[ornelis]
Overbrenging van mozaikziekte door beschadiging of aaraking van planten. Landbouwkd, Tijidschr. No. **509**: 512–517, 1930.

Dosdall, Louise

A mosaic disease of Gladiolus. Phytopathology **18**(2): 215–217, 1928

A description of the disease with evidence that it is due to a virus.

Doty, R[alph] E[are]

A yellow stripe disease survey. H. S. P. A. Expt. Sta. Circ. **35**, 71 p., 1920

Dover, C.

Preliminary report of the sub-station using spike-disease of Sandal (*Santalum album* Linn.) I An introductory survey of the problem Indian For. Rec. Calcutta **17**(1): 1–53, 1932.

Doyer, Lucie C[hristine]

Iots over gozendheistvestand der zaaizden in verschillende jarem. (Notes on the state of health of seed material in different years.) Tijdschr, over Plantenziekten **34**(4): 65–74, 1930.

Popular discussion of bean mosaic.

Untersuchungen uber den Gesundheitsszuztand des Saatguts. (Investigations on the state of health of seed) Comp. Rend. Assoc Internat. d'Essais de Semences 13–13, p. 41, 1930 (English Summary)

The author gives a scheme of classification of the various types of seed injuries, including infection by parasitic fungi and virus diseases. Important examples of each are discussed.

Drake, C. J., Tate, H. D., & Harris, H. M.

Preliminary experiments with Aphids as vectors of yellow dwarf. Iowa Sta Coll. Journ. Sci. **63**: 347–355, 1932.

A description of the methods The vectors are bean aphid (*Aphis rumicis*), apple green aphid (*Rhopalosiphium prunifoliae*), green peach aphid (*Myzus persicae*), melon aphid (*Aphis gosypii*), potato aphid (*Macrosiphum gei*) and corn aphid (*Aphis maidis*).

Insects as vectors of yellow dwarf of onions. Science n.s. **75** (1943): 341–342, 1932.

A report of recent studies on insect vectors. The disease has been transmitted by *Aphis rumicis*, *A. maidis*, *Rhopalosiphium prunifoliae* and *Cicadula sexnotata*.

---------, **Harris, H. M., & Tate, H. D.**

The relationship of aphids to the transmission of yellow dwarf of onions. Journ. Econ. Ent. **26**(4): 841–846, 1933.

The authors found over 50 distinct species of aphids in Iowa. They found them capable of transmitting the disease during their first feeding on diseased plants and 3 or 4 days after the plant has been inoculated by the aphids it becomes a source of infection and harbours the virus. The aphid loses its virulence very quickly. A list is given of the species of aphids studied which are capable of acting as vectors of yellow dwarf in field and greenhouses.

Dschounkowsky, E.

Le "mosaïque" du tabac. (Tobacco mosaic.) XIV éme Congrés Intern. D' Agric. R. **13**(4): 1–2, 1929.

Duboys, C[harles]

Project relatif á l'organisation départementale de la sélection de la Pomme de terre parles offices départamentaux de la région de l'Quest. (Projects in relation with the departamental organization of potato selection for the offices of the department of the west region.) Off. Agric. de l'Quest, 1921

Quelques conseils sur la sélection de la Pomme de terre dans la lutte contre les maladies dites de dégénérescence. (Some advices on potato selection in the fight against the so-called degeneration disease.) Off. Agric. Rég. de l'Quest, 1921.

La sélection de la Pomme de terre en Hollande. (Potato selection in Holland.) Off. Agric. Rég. de l'Quest, 1921.

La lutte contre la dégénérescence des pomme de terre dans l'Ouest de la France. (The campaign against degeneration, of potatoes in the West of France.) Rev. Bot. Appl. **2**(14): 586–589, 1922.

Duchartre, P.

Innoculation de la panachure par la greffe; Exposé historique. (Inoculation of mottling by grafting; historical account.) Belgian Hort. **20**: 113–118, 1870.

Ducomet, V[ital]

Station de physiologie et de pathologie des plantes cultivées. Semmis de Pomme de terre. (Physiology and pathology station for cultivated plants. Potato seeds.) Ann. Ec. Nat. Grignon **1920–21**: 114–142, 1921.

De la dégénérescence des végétaux multipliés par vois asexuée. (The degeneration of the plants propagated by the asexual way) Journ Soc Nat d'Hort France, Juillet, 1921.

Observations et expériences sur les maladies de dégénérescence de la Pomme de terre (Observations and experiments on degeneration diseases of the potato) Bull Soc Path Vég France 9(1) 29–38, 1921

Gives the results of studies at various altitudes. Seventy varieties were studied and none were free from degeneration diseases. Found the leaf-roll and curly leaf on *Solanum maglia*, *S commersonii* and *S. calcasii*

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Notes sur les maladies de la dégénérescence de la Pomme de terre (Notes on the degeneration of potatoes) Rev Bot. Appl et Agric Col 2 325–330 1922 (Min Agric. Ann Epiphyties 8 27–93, 1922)

The authors believe these diseases due to leaf-roll, mosaic and simillar diseases.

Sur la visibilite des symptomes de la mosaique de la Pomme de terre (Visibility of potato mosaic symptoms) Rpt Int. Conf Phytopath & Econ Entom p, 29–43 H Veenman & Sons Wageningen 1923

A record of additional symptoms on mosaic plants

Les principales maladies de la Pomme de terre Les moyens de les prévenir La selection Conservation des tubercules (The principal diseases of the potato Means of preventing them selection and preservation of the tuber) Offs. Agric p 16 Librairie Agric de la "Maison Rustique" Paris, 1923.

Dégénerescence de la Pomme de terre et degré de maturité du tubercule semence (The degeneration of potatoes and the stage of maturity of the seed tuber) Rev Path Vég. et Ent. Agric. 11(3) 183–188, 1924

Tubers that are harvested early produced plants with less leaf-roll than tubers that were harvested later

Dégénérescence de la Pomme de terre. (Degeneration of the potato) Ann. Econ Nat d'Agric. Grignon 1921–1922, 8· 96–136, 1924.

Les maladies de la Pomme de terre. Caractéres auxquels on les reconnait. Moyens de les combattre et de les prevenir. (Diseases of the potato. Characters by which to recognize them. How to control and prevent them.) Librairie de la "Maison Rustique", Paris 32 p., 1925.

Nouvelles observations sur la filosité de la Pomme de terre. (New observations on "Filosité" of potato.) Rev. Path. Veg et Ent. Agric. **13**: 172–178, 1926.

This disease may be associated with leaf-roll or other virus diseases.

Maladies de dégénérescence de la Pomme de terre. Comptes Rendus Séances Congrés Nationale pour la lutte contre les ennemies des Cultives, tenu á Lyon en juin 1926. (Degeneration diseases of the potato. Proceedings of the National Congress for the fight against the enemies of crops, held at Lyon on June 1926.) Sev. Agric. du P.L.M., **1927**: 68–82 1927.

La mosaïque de la betterave. (Mosaic ot sugar beet.) Rev. Path Vég. et Ent. Agric. **15**(1): 24–29, 1928.

The author gives results in graphics and tables of an experiment with two lines of mosaic sugar beets. He reaches the conclusion that although the weight remained apparently the same in the yield there is a difference of 1 per cent in sugar content in favor of the healthy beets. 16 per cent compared to 17 per cent.

La filosité de la Pomme de terre, maladies á crises. ("Filosité" of the potato, an intermittent disease.) Rev. Path. Vég. et Ent. Agric. **15**(7): 184–185, 1928.

Continnation of previous experiments. In this case the author started with 15 tubers of the 1924 crop. Planting year after year lead to the conclusion of intermittency. Advises roguing for control.

La mosaïque de la Betterave et la selection. (Beet mosaic and selection.) Bull. Assoc. Intern. Selectionneurs de Plantes de Grande Cult. Gembloux **2**(2): 44–48, 1929. (Abstract in Resumption Genetica **4**(5): 242, 1930. Rev. Appl. Mycol. **9** (10): 620, 1929.

These experiments have demonstrated the possibility of transmitting beet mosaic by seeds and by infection from Aphis.

Duffield, C[harles] W[illiam]

Nettle head in hops. Ann. Appl. Biol. **12**(4): 536, 1925.

This disease was supposed to be due to nematodes. Cause is doubtful as some characteristics are of a virus disease.

Dufrénoy, Jean

Les maladies de Pomme de terre dans les Haute Pyrénées. (Diseases of the potato in the High Pyrenees.) Bull. Soc. Path. Veg. France **8**: 137–138, 1923.

La transmission des maladies des plantes par voie biologique. (The transmission of plant diseases by biological means.) Report of a paper read before the Société de Pathologie comparée on the 10th of April 1923, 9 p. (Rev. Gen. des Science 32(13): 389. 1923.)

Le tabac blanc. (White tobacco.) Ann. Epyphites **13**: 43–47, 1927.

La mosaique de la canna de sucre. (Sugar cane mosaic.) Ann. Epyphites **14**(1): 25–36; (3): 199–210, 1928.

Introduction a l'étude cytologique des plantes affectées par des maladies a virus. Ann. Epyphites **14**(2): 163–174, 1928.

The author studies the plastids and mitochondria of both fresh and fixed material of mosaic plants. The degeneration of the cell contents appeared to be analogous to that caused by certain physio-chemical agents and to certain fungi and bacteria.

Les mosaiques du tabac. (Mosaic of tobacco.) L'Off. Agric. Regional du Massif Centrale Bull. **9**: 3–11, 114–125, 1928.

Condition d'hypotomie des cellules affectées par la mosaique. (Hypotomic conditions of cells affected by mosaic.) Compt. Rend. Soc. de Biol. **98** (17): 1499–1500. 1928. (Rev. Appl. Mycol. **7**(10): 660. 1928.)

The author found that epidermal tissue of leaf affected with mosaic disease showed vesicular alteration of the plastids and mitochondria. The staining of the vacuoles by neutral red is very irregular in the discolored areas. It was shown that cells of the mosaic tissue were in a marked hypotomic condition.

Les vacuomedes cellules de Canne de sucre affecteés de mosaïque. (The vacuoles of the cells of sugar cane affected with mosaic.) Compt Rend Soc. Biol **99** 503–505, 1928

Cytological studies ot plant tissue affected with mosaic disease. Phytopathology (Abstract) **18**(1) 154, 1928.

Modifications des mitochondries et des planties dans less cellules des Haricots affectées de mosaique (Modifications of the mitochondria and the plastids within the cell of the leaves of beans affected with mosaic) Compt Rend. Soc. Biol. **98**(5) : 373–374, 1928

La mosaique du blé, (Wheat mosaic) Bol R Staz Pat. Veg. Florenz, n.s **9**(3) · 298–304, 1929

Discussion and description of the disease based on McKinney's studies.

Changes induced in cells ot sugar cane by mosaic. Proc. Pacific Sci Cong. (Java) **4**(4) 25–27, 1929.

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La mosaique des feuilles du Monioc au Cameroun. (Mosaic of Cassava leaves in the Cameroons) Rev Bot Appl **9**(94). 361 365, 1929 (Rev Appl Mycol, **9**(1) 11, 1930)

The disease is severe in the Cameroons and in the greater part of West Africa.

Les maladies á virus aux États Unis (Virus diseases in the United States.) Rev. Bot Appl et Agric Trop. **9**(9) : 685–693, 1929.

Les maladies á virus chez les Vegetaux (Virus diseases of plants.) Rev. Path Hyg. Gen. (366–367) : 1–18, 1929.

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Études cytologiques sur la mosaique du tabac. (Cytological studies on tobacco mosaic.) Rev. Path. Vég et Ent. Agric. **16**(3) : 106–117, 1929.

This paper gives the results of studies on the mitochondria, striated and vacuolated bodies in cells of mosaic plants.

Les recéntes études cytologiques relatives aux maladies á virus. (Recent cytological studies in regard to virus diseases.) Rev. Path. Comp. et Hyg. Gen. **5**: 213, 229, 366–367, 1929.

La Canne á Sucre en Florida. (Sugar cane in Florida.) Rev. Bot. et Agric. Trop. **9**: 34–38, 1929.

Études cytologiques relatives aux maladies á virus. (Cytological studies relating to virus diseases.) Phytopath. Zeitschr. **1**(2): 151–167, 1929. (Rev. Appl. Mycol. **9**(1): 47, 1930.)

La mosaïque de la Canne á Sucre. (Sugar cane mosaic.) Ann. Epiphities **14**(3): 199–210, 1929. (Rev. Appl. Mycol. **9**(1): 61, 62, 1930.

The disease causes a modification of the vacuolar system of the cells and appears to prevent the mitochondria from developing into chloroplasts.

Les taches du tabac. (The tobacco spots.) Bull. Off. Agric. Massif, Central, **10**: 121–123, 1929.

Leaf tissues may be killed by virus diseases developing white spots or ring spots. The living cells surrounding these spots show a degeneration of the chloroplasts, plastids and cytoplasm.

Étude cytologique des taches blanches du tabac. (Cytological study on the white spots of tobacco.) Rev. Path. Vég. Ent. Agric. **16**(4–5): 146–159, 1929.

The changes induced in the cytoplasmic structure of cells by virus diseases. Fifth Int. Bot. Congr. Cambridge, **1930**: 367–368, 1930.

Les maladies á virus chez les plantes. (Virus diseases of plants.) Rev. Gén. Sci. **41**(8): 237–243, 1930.

A discussion of the desintegration of the plastids. The starch is translocated and the plastids appear as vesiculated bodies.

Études cytologiques relatives aux maladies á virus. (Cytological studies in relation with virus diseases.) Phytopath. Ztschr. **2**(1): 151, 1930.

Les maladies á virus au Congrés de Botanique de Cambridge. (The virus diseases in the Botanical Congress at Cambridge.) Rev. Path. Compt. (Paris) 12 p., 1930.

Maladies á virus du Tabac. (Virus disease of tobacco.) Phytopath. Ztschr. **2**: 321–340, 1930.

A description of the contents of cells from healthy and virus tobacco as seen under the ultramicroscope.

Les mosaïques des plantes tropicales et subtropicales de l'Ouest Africain. (The mosaic of tropical and subtropical plants of West Africa.) Rev. Bot Appl. & Agric. Col. **10**(107): 568–571, 1930.

Notes on manihot, tobacco, peanuts and capsicum virus diseases.

Les modifications pathologiques de structure des cellules végéales. (The pathological modification of the vegetable cell structure.) Ann. Inst. Nat. Agric. 2 ser. **23**: 1–104, 1930.

La modification locale du cytoplasme des cellules végétales affectées par des virus. (Local modification of the cytoplasm of vegetable cells affected with mosaic.) Compt. Rend. Soc. Biol. (Paris). **107**(21): 868–870, 1931.

La rétention de l'eau par la cellule végétale: maladies d'hypotonie et maladies d'hypertonie. Rev. Path. Compt. et Hyg. Gén. **31**: 212–223, 1931.

A study in physiology. Mosaic inhibits photosynthesis and the sugar content is low. Other diseases cause carbohydrates to be stored.

Mosaique des tulips. (Mosaic of tulips.) Compt. Rend. Soc. de Biol. **108**(27): 51–53, 1931.

The author described a mosaic in France which is similar to "breaking" in England.

Cytologie des cellules de plantes affectées par des maladies á virus et de plantes carencées. (Cytology of the cells of plants affected and not affected with virus diseases.) Second Intern. Cong. Path. Compt. (Paris) **1**: 309, 1931.

Deuxième congrès de pathologie comparée Second Intern. Congress of comparative pathology) (Paris) Oct 14–18, 1931 Phytopath Ztschr 4 455–459, 1932

Discussion of virus diseases

Die viruskrankheiten (The virus diseases) Phytopath Ztschr **5**(1) 75–83 1932

A study of the effects of mosaic of the chondriome The author used Boriel's supercolation technique for the study of epidermal cells

Die viruskrankheiten (The virus diseases) Phytopath Ztschr **5**(1) 85–90 1932

He reports clear breaking and selfbreak Transmitted by *Myzus persicae* and *Macrosiphum gei*

Differentiation of green and yellow mosaic virus in tobacco Phytopathology (Abstract) **23**(1) 10, 1933

Duggar, B[enjamin] M[inge], & Karrer J[oanne] L[aura] *

The size of the infective particles in mosaic disease of tobacco Ann Missouri Bot Garden **8**(2) 343–355 1921

Gives the results of experiments with filters which indicate the possibility of a minute organism

--------, & Armstrong, J[oanne] K[arrer] *

Indications respecting the nature of the infective particles in the mosaic disease of tobacco Ann Missouri Bot Garden, **10**(3) 191-212 1923

After a general discussion of the subject, the authors give a review of enzyme, bacterial and protozoa theories This is followed by a very excellent discussion of the nature of the causal agent

The effect of treating the virus of tobacco mosaic with the juices of various plants Ann Missouri Bot Garden **12**(4): 359–366 1925

The authors give the results of mixing the juice from tobacco mosaic plants with the juice of other plants and pokeweed juice on *Bacterium prodigiosum*

Effects of certain organic substances on the virus of the typical tobacco mosaic Amer Journ Bot (Abstract) **16**(10): 845, 1929

* Her papers have appeared under these two different names

The nature of mosaic diseases Proc Intern. Congr Plants Sci. Ithaca, New York **2**:1231–1242, 1929.

The author reports the results of grinding and filtration experiments and says,—"I am forced to the conclusion that the infectious agency is a particle of almost inconceivably small size, certainly too small to represent an organism with the usual characteristics.

Some significant properties of the virus of typical tobacco mosaic Science (Abstract) **69**(1795) · 555, 1929.

The problem of seed transmission of the typical mosaic plant. Journ of Bact 19(1) 20, 1930 (Rev Appl Mycol. 9·413, 1930. Phytopathology (Abstract) **20** 133, 1930.

The results of experiments with protein and other complex substances which may be involved in the absorption of mosaic virus of tobacco A considerable variety of seeds were used in this work. The author calls attention to the probability of some relationship of transmission of the virus to absorption and its inactivation by stored proteins

Standardization technique in certain studies Phytopathology (Abstract) **20**(1) 141, 1930

------ --, & **Hollaender, A.**

Ultra violet radiation Science n s (Abstract) Suppl. **72**(1988): 26, 1933

The authors report that mosaic virus was found to resist up to 150 times the amount sufficient to kill one of the bacterial species.

Standardization and relative purification technique with plant virus preparations Proc. Soc. Exper. Biol. & Med. **30**(8): 1104–1109, 1933

The author describes his tentative standard method for the relative purification of the tobacco mosaic virus.

---------, & **Johnson, Burt**

Stomatal infection with the virus of typical tobacco mosaic. Phytopathology **23**(12):934–948, 1933.

In this paper there is presented a discussion of the technique of spraying tobacco leaves with a virus suspension in the effort to determine whether or not stomatal infection may occur.

---------, & **Hollaender, A.**

Irradiation of plant viruses and of microorganisms with monochromatic light. I–II. Journ. Bact. 27:219–239, 241–256, 1934.

Dunlap, A[lbert] A[tkinson]

The chlorophyll content of normal and mosaic leaves of tobacco. Amer. Journ. Bot. (Abstract) **15**(10): 622, 1928.

Effects of mosaic upon the chlorophyll content of tobacco. Phytopathology **18**(8): 697–700, 1928.

Diseased plants contain less chlorophyll than normal plants.

Changes in total nitrogen, total carbohydrates, and carbon dioxide production in leaf tissue, caused by virus diseases. Amer. Journ. Bot. (Abstract) **16**(10): 844–845, 1929.

The total nitrogen and carbohydrates, and the relative rates of respiration in virus-infected plants. Amer. Journ. Bot. **17**(5): 348–357, 1930.

These experiments showed an increase in nitrogen and a decrease in carbohydrates in the foliage of mosaic plants, and the reverse in peach yellows.

The carbohydrates of healthy and mosaic tobacco leaves. Amer. Journ. Bot. (Abstract) **17**(1047), 1930.

Carbohydrate variations accompanying the mosaic disease of tobacco. Amer. Journ. Bot. **18**(5): 328–356, 1931.

Tobacco mosaic diseased plants showed a reduction in the amounts of reducing sugars, disacharids, dextrin, starch and pentosans. The starch appeared to be converted into simpler compounds. Sugars accumulated to greater degree in mosaic plants.

Duriez, C.

A propos des maladies de dégénérescence de la pomme de terre. (In regard to potato degeneration diseases.) Rev. Hort. **49**(14): 367–368, 1927.

Durrel, L[aurence] W[ood]

Notes on early dwarf symptoms on Irish potatoes. Phytopathology (Abstract) **7**(1): 71, 1917.

Dvorak, M[ayne]

The effect of mosaic on the globulin of potato. Journ. of Infect. Diseases. **41**(3): 215–221, 1927.

The author concludes that the disease has had an influence on the precipitation of the globulin.

Dyckerhoff, F.

Infektionsversuche mit der Rubenblattwouze (*Piasma quadrata*) au Zukerrubenkeimlingen im Jahre. Auzeig. Schadlingskunde **3**: 78–84, 1927.

Bemerkunde zu dem Aufsatz von K. Boning: Ist die durch die Blattwauze hervorgerufche Erkrankung der Rube cine Viruskranheit? Auzeig. Schadlingskunde **4**: 17–18. 1928.

Dykstra, T[heodore] P[eter]

Leafroll transmission from potato to other solanaceous plants by means of *Myzus persicae*. Phytopathology **20**(10): 853, 1930.

Weeds as possible carriers of leaf roll and rugose mosaic of potato. Journ. Agric. Res. **47**(1): 17–32, 1933.

Report of experiments in transmission of leaf-roll and rugose mosaic of potatoes to solanaceous weeds.

The author concludes that the investigations have established that under certain conditions solanaceous weeds growing in proximity to potatoes may become infected with certain virus diseases of the crop, and may serve as sources of the infection in the crop.

Earle, F[ranklin] S[umner]

Health and disease plants. Journ. N. Y. Bot. Gard. **3**: 195–202. 1902.

A popular paper in which the author refers to peach yellows, tobacco mosaic, etc.

Instrucciones para la eradicación de la enfermedad de la caña. (Instructions for the sugar cane disease eradication.) Ins. Expt. Sta. Porto Rico Circ. **14**: 6–8. 1918.

Recommends the planting of healthy canes and roguing.

Informe leído ante la Asociación de Productores de Azúcar de Puerto Rico. (Report read before the Sugar Producers' Association of Porto Rico.) Rev. Agric. Puerto Rico **2**(1): 5–10, 1918.

Eradication as means of control in sugar cane mosaic or yellow stripe. Ins. Expt. Sta. Porto Rico Bull. **22**, 17 p., 1919.

Gives the results of field studies on distribution and methods of control and also of experiments to determine methods of transmission.

The Year's experience with sugar cane mosaic or yellow stripe disease. Journ. Dept. Agric. Porto Rico **3**(4): 3–33. 1919.

Gives the results of field studies for control.

The resistance of cane varieties to the yellow stripe disease. Ins. Expt Sta. Porto Rico Bull. **19**, 19 p., 1919.

Field studies to determine relative resistance and susceptibility.

The yellow stripe or sugar cane disease. Ins. Expt. Sta. Porto Rico Ann Rept. **1918–19**: 18, 1919.

Instrucciones para la eradicación de la enfermedad del mosaico de la caña. (Instructions for sugar cane mosaic disease eradication.) Sugar **21**: 51–52. 1919.

A brief popular discussion.

Carta Circular No. 4. (Circular Letter No. 4.) Rev. Agric. Puerto Rico **3**(1): 51–52, 1919.

The mosaic or new sugar cane disease. Louisiana Planter & Sugar Manuf. **63**: 167, 1919.

The author criticised Mr. R. M. Gray's article (Louisiana Planter & Sugar Manuf. 63:90) and declares that a stalk of cane once infested never recovers. Also states that Grey probably confused mosaic with other sugar-cane diseases.

El mosaico de la caña o matizado. El estado actual de la epidemia. (Sugar cane mosaic disease or mottling. The actual stage of the epidemic.) Ins. Expt. Sta. Porto Rico Circ. **22**, 8 p. 1920.

Review of the work done in the Island to eradicate the disease.

La extirpación del mosaico (Mosaic eradication.) Sugar **23**: 114–115, 1921.

Importantísima carta (Very important letter.) Cuba Rev. Agric. Com. & Trab. **1**(4): 68–70, 1921.

Annual Report of the expert in sugar cane disease, 1920–21. Ins. Expt. Sta. Porto Rico Ann. Rpt. **1920–21**: 59–62, 1921.

Experiences with mosaic disease Uba found to be immune in Cuba South African Sugar Journ **7**(5) 427–428, 1923 (Rev. Appl Mycol **2** 525 526, 1923)

In a report of the spread of the disease and on the immunity of some varieties

Mosaic disease danger Prompt action needed to stop its spread in Cuba Facts About Sugar **16** 230 231 1923

The disease is spreading rapidly in Cuba and very little is being done to control it.

Mosaic eradication urged (Urge la extirpación del matizado.) Facts About Sugar **19**(11) 253, 1923 (Rev Agric Porto Rico **13**(4) 249 250 Australian Sugar Journ **16**(3) 615–616. 1925)

Sugar cane mosaic and sugar cane chlorosis Facts About Sugar **19**(16) 372 1924

A discussion of the characters of true mosaic and chlorosis.

Kavangerie in Porto Rico (A reply to D W May) Facts About Sugar **21** 925 927, 1926

Controversy

Sugar Cane and Its Culture VII & 355 p, 24 figs New York. (Mosaic p 110–124), 1928

East, E[dward] M[urray], & Weston, Jr. W[illia]m H[enry]

A report on the sugar mosaic situation in February, 1924, at Soledad, Cuba Harvard Inst Trop. Biol & Med, Contrib. **1**, 52 p 1925 (Rev Appl Mycol **5**(10) 582–583 1926)

A statement of the purpose of this Journal and a discussion of the mosaic at Soledad, Cuba.

Immunity to sugar cane mosaic acquired by the host Proc. Nat Acad Sci **17**(6) 331–334, 1931. (Sugar News **12**(11): 795–796, 1931)

The author uses precipitin experiments according to the Uhlenhuth method. The tests not conclusive but are suggestive.

Eastham, J[ohn] W[illiam]

Some potato disease problems in British Columbia Sci Agric. **4**(3) 89–94, 1923

Plant disease survey of central British Columbia Agric. Journ British Columbia 9(10) 224–225, 233, 1923

Report of Provincial Plant Pathologist, Vancouver. British Columbia Dept Agric Ann Rpt 1929 24 135–139, 1930

Infectious chlorosis of roses, a record of this disease

Eastwood, H W

Bunchy top control Early identification, eradication of infective aphids and destruction of diseased stools Agric Gaz New South Wales 44(8) 611–614 1933

Recommendations of practical methods for the control of bunchy-top in bananas under New South Wales conditions

Eberhardt, & Chevalier

Un nouveau traitement pour les maladies de la Pomme de terre (A new treatment for the potato diseases) Rev Hort Algerie 30 9) 200 202, 1926

Eckerson, S[ophia] H[ennion]

An organism of tomato mosaic Bot Gaz 81(2) 204–209, 1926 (Contr Boyce Thompson Inst Plant Res 1 109 114)

The author found flagellate organisms causing the destruction of chloroplasts in mosaic tomatoes

———, & Kraybill, H[enry] R[eist]

Separation of fern leaf from mottling in tomato mosaic Phytopathology (Abstract) 17(1) 57 58 1927

Edgerton, C[laude] W[ilbur], et al

The mosaic disease Louisiana planter & Sugar Manuf 63 25 25) 350 1919

Stenographic report of a meeting of the Louisiana State Sugar Planters Association on the mosaic disease of sugar cane

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Mosaic or mottling disease of sugar cane Louisiana Agric. Expt Sta Div Agric Expt Circ 32, 6 p, 1919 (Louisiana Planter Sugar Manuf 62(25) 397 1919)

Popular discussion The presence of sugar cane mosaic disease is reported Similar or probably identical to that disease in Puerto Rico.

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A method of selecting L–511 cane free from mosaic disease for planting purposes Louisiana Agric Expt Sta Bull 176, 7 p, 1920 (Louisiana Planter & Sugar Manuf 65 (16): 252-253, 1920)

The character of this paper is indicated by the title

---------, & **Moreland, C[layton] C[apers]**

Sugar cane diseases. Louisiana Agric. Expt. Sta. Ann. Rpt. **1920**: 16–17, 1920.

---------, & **Tiebout, G[eorge] L[eroy]**

Mosaic disease of the Irish potato and the use of certified seed. Louisiana Agric. Expt. Sta. Bull. **181,** 15 p., 1921.

Describes the disease and gives the results of field tests with certified seed, effects on yield, and influence of climate.

Loss from mosaic. Louisiana Planter & Sugar Manuf. **71**: 30, 1923.

Department of Plant Pathology. Louisiana Agric. Expt. Sta. Ann Rpt. 1922. **34**: 17–18, 1923

---------, & **Taggart, W[illiam] G.**

Tolerance and resistance to the sugar cane mosaic. Journ. Agric. Res. **29**(10): 501–506, 1924. (Louisiana Planter & Sugar Manuf. **74**: 188 190, 1925. Rev. Appl. Mycol. **4**: 379, 1925.. Int. Sugar Journ **27**(321): 482-483. 1925.)

The disease spreads rapidly in Louisiana and roguing has not been successful. The results of tests with toleran: varieties are given.

---------, ------------, & **Tims, E[ugene] C[hapel]**

The sugar cane disease situation in 1923 and 1924. Louisiana Agric. Expt. Sta. Bull. **191,** 44 p., 1924 (Louisiana Planter & Sugar Manuf. **74**(5): 88–90, (6): 110–112, (7): 130–132, 1925. Rev. Appl. Mycol. **4**: 312–313, 1925.)

Gives the results of experimental work to determine resistance and tolerance.

Selecting for resistance to the sugar cane mosaic. Phytopathology (Abstract) **15**(1): 45–46, 1925.

---------, **Taggart, W[illiam] G., & Tims, E[ugene] C[hapel]**

The selection of cane seed. Louisiana Agric. Expt. Sta. Bull. **195,** 18 p., 1926 (Manila Daily Bull. **67**(62): 15, 1926).

This paper gives the results of experiments; were very suggestive and encouraging.

---------, & **Tims, E[ugene] C[hapel]**

Investigations on the sugar cane disease situation in 1925–26. Louisiana Agric. Expt. Sta. Bull. **197**: 3–7, 1927. (Rev. Appl. Mycol. **6**: 641–642, 1927).

The writers report obtaining varieties resistant to mosaic by selection of seed cuttings.

Disease resistant of P.O.J. 213 Cane. Sugar Bull. Nov. **15**, 1928. (Facts About Sugar **23**(50): 1190. 1928. Rev. Appl. Mycol. **8**: 264–265, 1928.)

A study of important varieties with reference to disease resistance.

-------------, **Tims, E[ugene] C[hapel] & Mil, P[ercy] J[oseph]**

Plant Pathology. Louisiana Agric. Expt. Sta. Ann. Rept. **1928–29**: 52–57, 1930.

Several years' investigations of the authors showed the tolerance to mosaic disease by certain strains of sugar cane.

Egiz, S[amuel] A.

Tabakovodstvo. Glavoe Upravlenie Zemledieüa i Zemleustroistva. Department Zemledielüa, Obshchchedostynnia Sorvschenüa sel skekhoiiaistvennykh Uchezhdnü i Spetsialistow po Sel' Skokhoziaistvennoı chasti (Russia), No. **9**, 1912.

Elliott, J[ohn] A[sbury]

A mosaic of sweet and red clover. Phytopathology **11**(3): 146–148, 1921.

The disease is the same as the mosaic of sweet clover (*Melilotus alba*), reported November 1920. Can be transmitted by cross-inoculation to *Vicia faba* and *Medicago arabica*.

Elmer, Otto H[erman]

Mosaic cross-inoculation studies. Iowa Acad. Sci. Proc. **29**: 205–206, 1922.

Very brief preliminary paper.

Mosaic cross-inoculation and insect transmission studies. Science n. s. **56**(1448): 370–372, 1922.

A preliminary paper. Iowa Agric. Expt. Sta. Res. Bull. 82 (1925).

Studies of insect transmission and cross-inoculation of mosaic on the *Solanaceae, Cucurbitaceae* and *Leguminosae*. Iowa Acad. Sci. Proc. **29**: 311–312, 1922.

Mosaic cross-inoculation studies. Phytopathology (Abstract) **14**(1): 55, 1924.

Transmissibility and pathological effect of the mosaic disease. Iowa Agric. Expt. Sta. Res. Bull. **82**: 39–91, 1925. (Rev. Appl. Ent. ser. A **13**: 563, 1926.)

This paper gives the results of a large number of cross-inoculation experiments. Also a considerable amount of data concerning insect vectors.

Inhibition of mosaic infection. Phytopathology (Abstract) **16** (1): 67–68, 1926.

A mosaic resistant variety of cucumber. Phytopathology (Abstract) **17**(1): 48, 1927. (Trop. Agric. (Trinidad) **4**: 135, 1927.)

Elze, D[avid] L[eon]

(Insect transmission of curl disease of potato.) Int. Conf. Phytopath. & Econ. Ent. Ann. Rpt. p. 35. H. Venman & Sons. Wageningen, 1923

De verspreiding van virusziekte nvan de Aardappel (*Solanum tuberosum*) door insects. (Transmission of virus disease of potato by insects.) Ins. voor. Phytopath. Lab. voor Mycol. en Aardappelonderzoch. Meded. **32**: 90, 1927. (With English summary. (Meded. Landbouwhoogschool Wageningen **31**(1): 1–90, 1927.)

A classification of virus diseases with reference to insect carriers. List of insects and the results of transmission experiments.

----------, **& Quanjer, H[endrick] M[arius]**

Phloemnecrose en netnecrose van de aardappel in America en Europa. (Phloemnecrosis and netnecrosis of the potato in America and Europe). Overgedrukt uit de Mededeelingen van de Landbouwhoogeschool. Deel **33**(8): 1–10, 1929. (Rev. Appl. Mycol. **9**: 47, 1930.)

The author made a comparative study of European and American potatoes with these diseases and gives a discussion of differences. He believes the leaf-roll on the two sides of the Atlantic to be the same.

Die Ubertragbarkekit mit dem Samen von aukuba-Mosaik sowie blattroll. (Phloemnekrose) der kartoffel. (The transmissibility by the seed of aucuba mosaic and leaf roll. (phloemnecrosis) of the potato.) Phytopath. Zeitschr. **3**(4): 449–457, 1931.

The author gives the results of experiments in which he transmitted these two diseases by the seeds and by grafting.

De overgang van virusziekten met het zaad, in het bijzonder

bijode aardappel. (The transmission of virus diseases through the seed, particularly in the potato plant.) Voordracht gehouden voor de Nederlandschs Planenzietekundige (Phytologische) Vereeningen op de Landbouweek te Wageningen op den 24 sten Juli 1931.) Tijdsch. Plantenziekt 37 (10): 189–199, 1931.

The author gives a review of the literature and the results of grafting aucuba mosaic, leaf-roll and healthy potatoes. Some of the plants contracted the diseases.

The relation between insect and virus as shown in potato leaf roll, and a classification of viroses based on this relation. Phytopathology 21(6): 675–686, 1931.

A discussion on the ability of several insects to transmit potato leaf-roll. Gives a classification based on relation of virus diseases to insects.

Emmerez de Charmoy, D[onald] d'

Mode de transmission de la mosaïque de la canne á sucre. (Mode of transmission of sugar cane mosaic.) Rev.. Agric. Ile Maurice 12: 240–341, 1923.

Mauritius Die Mosaikkrankheit des tabaks. (Mauritius: The mosaic disease of tobacco.) Inst. Landw. Rundschan. Rom. 19: 775, 1928.

____________, & Guézé, P.

Situation actuelle de la mosaïque á la Réunion. (Present situation of mosaic in Reunion.) Rev. Bot. Appl. & Agric. Trop. 13(143): 495–499, 1933.

Suggestions and description of suitable legislation tending to eradicate sugar-cane mosaic disease from Reunion.

Ensign, M[artin] R[ussell]

Sweet potato mosaic Phytopathology 9(4): 180–181. 1919.

The author describes the symptoms of the disease and compares yields with healthy plants and states that there is no evidence that it is transmitted directly to neighboring plants.

Eristavi, E. M., & Mordvintzeff, A. I.

A brief survey of plant diseases in Abkhasia in 1929. (English Summary) Abkhasia Agric. Expt. Sta. Sukhum 41, 20 p., 1930.

Brief notes on tomato mosaic and white leaf spot reported as virus disease.

Esau, Katherine

Studies of the breeding of sugar beets for resistance to curly-top. Hilgardia **4**(14): **415–441, 1930.**

The author gives a brief statement concerning the disease in the United States and experimental evidence with hybrids which indicate that it is possible to develop resistant varieties.

Sugar beet resistant to curly-top. Facts About Sugar **25**: 610–612. 1930.

Pathologic changes in the anatomy of leaves of the sugar beet, *Beta vulgaris*, affected by the curly-top disease Phytopathology **23**(9): 679–712, 1933.

An extensive account of the writer's studies on the subject at the California College of Agriculture. She states that curly-top induces pronounced anatomical changes in affected leaves involving hypertrophy, hyperplasia, hypoplasia and necrosis She explains and describes these disorders.

Cell degeneration in relation to sieve-tube differentiation in curly-top beets. Preliminary note. Phytopathology **24**(3): 303–305, 1934.

Brief preliminary notes of cytological studies made by the author.

Esmarch, F[erdinand]

Zur kenntnis des stoffwechsels in blattrollkanken Kartoffeln. (Studies on the metabolism in potato leafroll disease) Zeitschr. Pflanzenkr. **29**: 1–20, 1919. (Ang. Bot. 1: 125, 1919.)

Anatomical studies of leaf-roll. The author agrees with Quanjer in regard to the translocation of starch and concludes that rolling of the leaves occurs as a consequence of the disturbed metabolism present internally. He doubts however, that Quanjer's phloem necrosis may be regarded as cause of the reduced translocation of starch.

Beiträge zur Anatomie der gesunden und Kranken Kartoffelpflanze. Anatomie der vegetativen Organ. (Contribution to the anatomy of the normal and diseased potato plant. Anatomy of vegetative organs.) Landw. Jahrb. **54**: 161–266, 1919.

The author gives the results of extensive studies. He states that phloem of mature plants is always necrotic. Therefore, the phloem necrosis theory is obsolete.

Die phloemnecrose der Kartoffel. (Phloem necrosis of the potato) Ber. Deutsch. Bot. Gas. **37**: 463–470. 1919.

Phloem-necrosis is found in both healthy and diseased plants, especially mature parts. When present in young plants it is evidence of premature ripening. It is of no value in diagnosing leaf-roll.

Neues von der Blattrollkrankheit der Kartoffel. (News of the leafroll disease of potato.) Naturwiss. Wochenschr. N. F. 1919.

Neuere Anschauungen über dir Blattrollkrankheit der Kartoffeln. (New contemplation about the leaf-roll disease of the potato). Kartoffelzeitg. **13**(16). 1923. (Nachrichtenbl. Pflanzenschutzdienst **3**(4): 25–26, 1923.)

Blattrollkrankheit oder nicht? (Leaf-roll disease or not?) Sächs. Landw. Zeitschr. **74**: 543–545. 1926.

Das Blattrollen der Kartoffel. (The leaf rolling of the potato.) Die Kranke Pflanze **3**: 143–146, 1926.

Die Blattrollkrankheit der Kartoffel. (The leaf roll disease of the potato.) Monographien Zum Pflanzenschutz, **8**, 91 p., 1932.

This paper includes history, geographical distribution, economic importance, histology, physiology, transmission, environmental factors and control. The author believes the causal agent is a living entity.

Euler, [Chelpin] Hans [Karl August Simon] von, Hertzsch, W[alther Myrback] S., Runehjelm, D[agmar Elisabet] & Forssberg, A[rne Gunnar]

(Chemical changes in infectious chlorosis in leaves of Abutilon.) Arkiv. Kemi Mineral Geol. **10B**(13): 1–6, 1930. (Chemical Abstracts **25**(7): 1554. 1931.)

***Abutilon* leaves affected with infectious chlorosis are stated to be characterized by a much lower catalase activity, a higher proportion of amino nitrogen, less chlorophyll, xanthophyll and carotin, and less tryptophane than the normal green areas.**

Recherches chemiques sur l'action de deux virus des végétaux. (Chemical investigations on the action of two viruses of plants.) Second Intern. Congr. Comp. Path. Comp. Rend. Communications **2**: 459–461. 1931.

Comparative biochemical studies on tobacco plants suffering from mosaic, *Abutilon striatum* with infectious chlorosis and healthy plants.

———, & Moritz, O.

Chemische Beiträge zur Kenntnis der chlorophydefekte (Chemical contribution to the study of chlorophyll deficiency.) Ark Kemi Mineral Geol. Stockholm **10** A 1–15, 1931.

———, et al

Vergleichende Versuch über verschiedene Arten von Chlorophylldekten Zeitschr Indust. Abstamm. u. Vererbungsl. **60** 1 15, 1931

Evans, I[lltyd] B[uller] Pole

Report No VI, Botany and Plant Pathology Journ. Agric. Dept. South Africa **9**(6) · 542–546, 1924. (Rev. Appl. Mycol. **4** 332–333, 1925.)

Contains references to rosette of peanuts and mosaic and streak of sugar cane.

Evans, Paul

Peach rosette Missouri State Fruit Expt. Sta Bull. **11**, 1904.

A popular paper describing the disease

Eyer, J R., & Crawford, R[aymond] F[rank]

Observations on the feeding habits of the potato psyllid (*Paratrioza cockerelli* Sulc) and the pathological history of the "psyllid yellows which it produces. Journ. Econ. Ent. **26** (4) · 846–850, 1933

Description of the symptoms of psyllid yellows. Account of the authors' studies on the mode of feeding of the insect vector of the disease, *Paratrioza cockerelli*.

Eyles, F.

Tobacco mosaic in Southern Rhodesia. Selection for resistance. Rhodesia Agric Journ **23**(3) 248–252, 1926

A popular discussion.

Faes, H[enry]

Le portegreffes resistant á la chlorose (Stocks resistant to chlorosis) Prog Agric. et Vitie **83**: 83–85, 1925.

Fajardo, T[ranquilino] G[anzón]

Progress in the experimental work with the transmission of bean mosaic Phytopathology (Abstract) **18**(1): 155, 1928.

Studies on the mosaic disease of the bean (*Phaseolus vulgaris* L) Phytopathology **20**(6): 469–494, 1930.

There appears to be but one mosaic disease of the bean. It develops best at 20 to 28 degrees C., is partly masked at 28 to 32 de-

grees and completely masked at 12 to 18 degrees. The virus exists in all aerial parts of the plant and is transmitted in some seeds. It is also transmitted by *Aphis rumicis, Myzus persicae, Macrosiphum solanifolii* and a mealy bug

Studies of the properties of the bean mosaic virus. Phytopathology **20**(11): 883–888, 1930

The author continues his previous work. He compares the bean mosaic with other plant mosaic viruses and other mosaic types

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The mosaic disease of Sincamar *Pachyrhizus erosus* Urban, Phil. Journ. of Sci. **48**(2): 129-142, 1932

The authors describe a disease of sincamas,—*Pachyrhizus erosus* (*P. angulatus*)

Fallada, O.

(Diseases of sugar beets) Osterr. Unger. Ztschr. Zuckerindus. u. Landw. **39**(1): 42–48. 1910

Faris, J[ames] A[braham]

El mosaico de la caña de azucar. Historia de esta enfermedad en la caña Dominicana. (Sugar cane mosaic. History of this disease in the Dominican cane.) Rev. Agric. Santo Domingo **17**: 73-76; 90-95; 105–108. 1922. (Rev. Appl. Mycol. **3**: 437. 1923.)

A popular discussion of the disease and suggestions for the use of resistant varieties for control

Proc. 2nd Int. Conf. of Sugar Cane Technologists Havana p. 99-100. 1927

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Field control of sugar mosaic in Cuba. The Reference Book of the Sugar Industry of the World. **7**: 32–35. 1929

A popular discussion with a great deal of field data concerning Cuban conditions

Some pathological effects of the mosaic disease of sugar cane. Planter & Sugar Manuf. **82**(21): 404–405, 1929

El dominio del mosaico de la caña de azucar en el campo cubano. (The range of mosaic of sugar cane in cuban plantations.) Bol. Unión Panamericana **64**(9): 968–983, 1930

The author gives three marked zones that occur in Cuba in regard to the degree of spread of the disease. Gives the varieties best adapted to each zone and in each season.

The utilization of varieties in the field control of sugar cane mosaic and root disease in Cuba (A preliminary report) Trop Plant Res Foundation Scient Contr. **20,** 69 p., 1931.

The author gives a large amount of data demonstrating that the use of resistant varieties is the most satisfactory method for the control of these diseases.

Farquharson, C. O.

Reports of the Mycologist Nigeria Dept Agric **1912–1913.** 1913.

Record and description of a disease on cotton (*Gossypium peruvianum* and *G. vitifolium*) which the author names "Leaf curl" and has all the characteristics of a virus disease

Fawcett, G[eorge] L[orenzo]

Una enfermedad de la caña producida por condiciones desfavorables de clima y suelo (A sugar cane disease caused by unfavorable climatic and soil conditions) Rev Indus Agric. Tucumán **8** 136 140, 1917

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La enfermedad de las rayas amarillas de la caña (Yellow stripe disease of sugar cane) Rev Indus Agric Tucumán **10** 46 48, 1919

The disease is widely distributed on the Java varieties Kavangerie is immune and D 1135 is resistant

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Notas sobre la extirpacion del mosaico de la caña. (Notes on sugar cane mosaic eradication) Rev Indus Agric Tucumán **11** 74–76, 1920

The yellow stripe or mosaic disease in Argentina Louisiana Planter & Sugar Manuf **64** 41, 1920

Reports the disease as having been in Argentine for 15 years or more It is abundant but not serious.

Las primeras investigaciones sobre el mosaico en Java (The first investigations on mosaic disease in Java.) Rev. Indus. Agric Tucumán **11** · 121–123, 1920.

A review of the work of Kobus and Wilbrink and Ledeboer.

Enfermedades de la caña de azúcar en Tucumán. (Diseases of sugar cane in Tucumán.) Rev. Indus Agric. Tucumán **13**(1–2) : 1–46, 1922. (Reprinted: id. **15**(7–8) : 103–111, 1925.

Estación Expt. Tucumán Bol. No. **1**, 21 p., 1924. Rev. Appl. Mycol **2**: 338–340, **4**(6): 378, 1925.)

The author describes sugar-cane mosaic, which was found in all susceptible varieties cultivated in Argentine. The nature of the disease is unknown. It may be transmitted artificially, but the natural vectors are insects. Diseased canes always produce diseased plants; there is no possible cure at this time. Roguing as a means for eradication resulted in a failure, the only advisable method up to the present is the selection of healthy canes for planting.

La transmisión del mosaico. (The transmission of mosaic.) Sugar **25**: 684, 1923. (Rev. Indus. Agric. Tucumán **13**(7–8): 129-131, 1923 Rev. Appl. Mycol. **3**: 367–368, 1924)

A review of the work of Brandes and others on insect transmission.

La desinfección de la caña por la calefacción. (Sugar-cane disinfection by heat.) Rev. Indus. Agric. Tucuman **13**(11–12): 205-206, 1923.

This paper gives the results of attempts to control mosaic by treatment with hot water. The results were negative.

El mosaico de la caña de azúcar. (The mosaic of sugar cane.) Rev. Indus. Agric. Tucumán **14**(1–2): 6–8, 1923 (Rev. Appl. Mycol. **3**: 485, 1924.)

A popular discussion of the subject.

El mosaico o enfermedad de las rayas amarillas de la caña. (Mosaic or yellow stripe disease of the sugar cane.) Rev. Indus Agric. Tucumán **15**(7–8): 103–111, 1925. (Rev. Agric. Com. & Trab. Cuba **8**(1): 23-29, 1926.)

A popular discussion of the mosaic including information on vectors and method of control.

La desinfección de la caña. (Sugar cane disinfection.) Sugar **27**(1): 53, 1925.

A popular review of Dr. Wilbrink's hot-water treatment of cane.

Encrespamiento de las hojas de la remolacha azucarera. (Leaf curl of the sugar beet.) Rev. Indus. Agric. Tucumán **16**(3–4): 39–46, 1925.

Sugar beets of Argentine are attacked by a disease called "Encrespamiento" which is different from curly top. It is carried by a leafhopper, *Aceratogallia sanguinolenta*.

The curly top of sugar beet in Argentine Phytopathology **17** (6) 407–408, 1927

Agallia sticticollis Stal. transmits the disease.

Las manchas blancas de las hojas de la caña. (The white spots on the sugar cane leaves) Rev. Indus. Agric. Tucumán **17**: 259 261, 1927 (Louisiana Planter & Sugar Manuf. **80**: 263–264 1928)

El encrespamiento de las hojas de la remolacha y el insecto trasmisor (The curling of the leaves of the beet and the insect vector) Rev Ind Agric Tucumán **18**(5 6): 61–66, 1927.

Popular discussion.

Apuntes sobre el mosaico de la caña de azúcar. (Notes on mosaic of sugar cane) Rev. Indus. Agric. Tucumán **18** 11–12) 205–209, 1928. (Rev Appl Mycol. **7** 743, 1928)

A discussion of varieties not completely immune to mosaic.

Departamento de Botánica y Patología Vegetal. (Department of Botany and Plant Pathology.) Rev. Indus. Agric. Tucumán **18**(9–10) 172–174, 1928. (Rev. Appl. Mycol. **7**: 562, 1928)

Notes on different virus diseases of economic plants. Mosaic is the only important disease. Given the results of tests of P. O. J. 2725.

La clorosis de la caña recién brotada. (Chlorosis of recently sprouted cane) Rev Indus Agric. Tucumán **19**(7–8): 214–215, 1929.

El cultivo y las plagas del tabaco (The cultivation and plagues of tobacco) Rev Indus. Agric. Tucumán **19**(7–8): 215–216, 1929.)

A brief note.

Las plantaciones de caña sin mosaico en Tucumán. (The cane plantations free from mosaic in Tucumán). Rev. Ind. Agric. Tucumán **21**: 126–127, 1931.

Report of the negative results obtained in Argentine by the roguing method for eradication of sugar-cane mosaic.

Fawcett, H[oward] S[amuel]

New symptoms of psorosis, indicating a virus disease of citrus. Phytopathology (Abstract) **23**(11): 390, 1933.

Account of record of the observations made by the author of this disease. Transmission by budding and by root cuttings was successful. He also suggests that two other citrus diseases, leprosis and ring blotch, with symptoms on older leaves of the same general nature, should be investigated as to the possibility of their virus origin.

New information on psorosis or scaly bark of citrus. California Citrograph **18**(12): 326, 1933.

Additional data in regard to the new virus disease studied by the author.

Fenne, S. B.

Field studies of the ringspot disease of Burley tobacco in Washington County, Virginia. Phytopathology **21**(9): 891–899, 1931.

Steam sterilization of soil did not prevent the disease. The stick weed (*Verbesina alternifolia*) and sweet clover (*Melilotus alba*) are natural hosts.

Ferdinandsen, C[arl Christian Frederik], Rostrup S[ofie] & Ravn, F[rederik] K[olpin]

Oversigt over Landbrugsplanternes Sygdomme i 1917 (Report on Diseases and pests in farm crops in 1917.) Denmark. Tidskr. Plantev. Landbr. **25**: 314–340, 1918.

The authors mentioned 69 plant diseases in the report, among which mosaic disease on beets caused a loss of 50 per cent of the crop and potato leaf roll was listed as very conspicuous.

Ferguson, John H.

The particle size of biological units. Journ. Phys Chem. **36** (12): 2849 2861, 1932 (Rev. Appl Mycol. **12**: 308, 1933.)

A review.

Fernow, Karl H[ermann]

Spindling tuber or marginal leaf-roll. Phytopathology (Abstract) **13**(1): 40, 1923.

A new host for potato mosaic (*Nicandra physaloides*) Phytopathology (Abstract) **13**(1): 40–41, 1923.

Interspecific transmission of mosaic diseases of plants. Cornell Univ. Agric. Expt. Sta. Memoir **96**: 3–34, 1925.

The author gives the results of a large number of cross-inoculation experiments. He says—"A review of the literature discloses also the fact that most authors have omitted consideration of a factor here shown to be important, namely, the identity of the mosaic concerned."

Potato growing in Bermuda. Amer. Potato Journ. **8**(6): 150–153, 1931.

Leaf-roll potato plants give no yield in Bermuda.

----------, & Black, L. M.

Yellow dwarf in New York State. Amer. Potato Journ. **9**(7): 116–117, 1932.

The disease has been known since 1917, severe in recent years. The severity appears to be correlated with dry weather and high temperature.

A partially masked mosaic of potatoes. Amer. Potato Journ. **10**(12): 235–245, 1933.

Report of results of experimental work, given in tabular form, followed by a discussion of its interpretation.

Ferraris, T[eodoro]

Peach yellows, peach rosette e l'arriciamento del pesco in piemonte. Curiamo le Piante. Torino **6**: 101–114, 1928.

Fife, J. M.

A method of artificial feeding the sugar-beet leafhopper. Science n.s. **75**(1938): 465–466, 1932.

A description of the method.

Figueroa, C[arlos] A[rturo]

The mottling disease of cane and the sugar production of Porto Rico. Journ. Dept. Agric. Porto Rico **3**(4): 35–43, 1919.

A statistical study to determine the extent of the losses.

Filho, A. F. O.

O combato contra o "Mosaico" de canna de assucar. (The fight against the "mosaic" of sugar cane.) Brazil Agric. **12**: 65–70, 1927.

Finch, A[lton] H., & Kinnison, A[llen] F[isher]

Pecan rosette: soil, chemical and physiological studies. Arizona Agric. Expt. Sta. Tech. Bull. **47**: 407–442, 1933.

According to the authors' statement pecan rosette has been in Arizona for over twenty years, and caused the abandonment of the orchards in several counties. They present a fully detailed account of their study of this disturbance.

Findley, W. M.

Potato golden wonder and virus diseases. Gard. Chron. **77** (1992): 154, 1925.

Brief popular notes.

Fisher, C[ecil] E[rnest] C[laude]

Cause of the spike disease of sandal (*Santalum album*). Indian Forester **44**: 570–575, 1918.

The author adheres to the idea of infectious nature of the disease in opposition to the autogenetic theory in support of Coleman statements. It is suggested that the disease was introduced by American missionaries on *Lantana Camara* which suffers from a disease whose agent is ultra-microscopic and carried by sucking insects.

Fletcher, T[homas] B[ainbrigge]

Report of the Imperial Entomologist. Agric. Inst. Pusa (India) Sci. Rpt. **1926–27**: 56–67, 1928. (Rev. Appl. Ent. Ser. A. **16**: 357–358, 1928.)

Flexner, S[imon]

Some problems in infection and its control. Science n.s. **36**: 685–702, 1912.

Believes that tobacco mosaic is caused by ultra-microscopic organism or filterable viruses.

Foex, [Edmond] E[tienne]

La maladie de l' enroulement des feuilles de Pomme de terre dans le conton d' Orchis nord. (The potato leaf-roll disease in the North Orchis District.) Bull. Soc. Path. Vég. France 1: 42–48, 1914.

————————, **& Perret, Claude**

Maladies dan Pomme de terre (Potato diseases.) Vie. Agric. et Rurale **3**(5): 129–134, 1914.

Quelques causes de dégénérescence chez la pomme de terre. (Some causes of degeneration of the potato.) Journ. Soc. Nationale Hort. (France) **21**: 204–207, 1920.

A description of leaf-roll and mosaic and a discussion of a paper by Emile Schribaux.

Quelques causes de dégénérescence chez la pomme de terre. (Some causes of degeneration in the potato.) Compt. Rend. Acad. Agr. France **1920**: 398–407, 1920.

La nécrose du liber de la tige de Pomme de terre atteinte de la maladie de l' enroulement. (Stem necrosis in potatoes affected with leaf roll.) Compte Rend. Acad. Sci. (Paris) **170**(22) : 1336–1339, 1920.

La dégénérescence de la Pomme de terre. (Degeneration of the potato.) Journ. Agric. Pract. **33** : 275–279, 326–329, 344–346, 365–367, 1920.

La maladie de l' enroulement de la pomme de terre. (The leaf roll disease of potato.) Ann. Epiphytes **7** : 281–287, 1921.

This paper gives the results of microchemical studies on phloem necrosis.

Enroulement et leptonécrose. (Leaf-roll and leptonecrosis.) Bull. Soc. Path. Vég. (France) **8** · 148–149, 1921.

Les relations entre leptonécrose et l' enroulement. (Relations between leptonecrosis and leaf-roll.) Bull. Soc. Path. Vég. (France) **8**(1) : 25–29, 1921.

A résumé of Quanjer's studies.

Maladies á virus filtrants. –Mosaïque. (Filterable virus diseases.—Mosaic.) Rev. of (1) Butler, Edwin John. Some characteristics of the virus diseases of plants. Sci. Prog. **17** : 416–431, 1923. (2) Dickson, Bertram Thomas. Studies concerning mosaic diseases. MacDonald Agric. Coll. Tech. Bull. **2**, 125 p. 1922. (3) Nelson, Ray. The occurrence of protozoa in plants affected with mosaic and related diseases. Michigan Agric. Expt. Sta. Tech. Bull. **58**, 28 p. 1922.) Rev. Path. Vég. et Entom. Agric. **10** : 88–93, 1923.

This paper is a review of papers by Butler, Dickson and Nelson as mentioned above and a discussion of the enzymatic and parasite theories.

Les maladies á virus chez les végétaux. (Virus diseases of plants.) Rev. Path. Compa. **25**(272) : 241–256, 1925; **26**(293) : 39–73, 1926.

Folsom, Donald

Potato mosaic. Maine Agric. Expt. Sta. Bull. **292** : 157–184, 1920.

Description and comment on effects of the disease. A study of methods of transmission and control.

__________, **& Schultz, E[ugene] S[chultz]**

Potato leaf roll. Maine Agric. Expt. Sta. Bull. **297**: 37–52, 1921.

Describes the disease and discusses methods of transmission and control.

Potato spindle tuber. Maine Agric. Expt. Sta. Bull. **312**: 21–44, 1923.

Gives general discussion of the disease which is carried in the juice containing parts of the plant and is transmitted by Aphis. Gives recommendations for its control by seed selection, roguing and isolation.

__________, **& Schultz, E[ugene] S[chultz]**

The importance and natural spread of potato degeneration diseases. Maine Agric. Expt. Sta. Bull. **316**, 28 p., 1924.

Gives the effects of those diseases on yield, based on experimental field studies.

Advances in the study of virus diseases of Irish potatoes in 1923. Potato Ass'n. Amer. Proc. 10th Ann. Meeting p. 39–42, 1924.

A popular discussion of the subject.

Experiments and observations in Maine, 1924. Potato News Bull. **1**: 316–317, 1924.

Rugose mosaic reduced the yield five times more than mild mosaic. Witches' broom was reported from Maine and transmitted experimentally.

__________, **& Schultz, E[ugene] S[chultz]**

Methods of conducting the seed plot and its importance in potato improvement work. Potato Ass'n Amer. Proc. 12th Ann. Meeting, 1925.

A popular discussion.

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Methods to be observed to prevent spread of virus diseases in potatoes grown from seed stock. Potato Ass'n Amer. Proc. 1925 Ann. Meeting **11**: 20–26, 1926.

Popular.

Virus diseases of the potato. Quebec Soc. for Prot. of Plants 18th Ann. Rpt. **18**: 14–29, 1926.

A popular review of the subject.

----------, **Schultz, E[ugene] S[chultz], & Bonde, R[einer]**

Potato degeneration diseases. Natural spread and effect upon yield. Maine Agric. Expt. Sta. Bull. **331**: 57–112, 1926.

This paper gives much valuable data concerning the effect of these diseases on yield and on the spreading of diseases.

Uniformity of nomenclature for the viruses of *Solanum tuberosum*. Phytopathology **17**(3): 161–165, 1927. (Maine Agric. Expt. Sta. Bull **342** (Abstract) p. 234–235, 1927.)

The author discusses the desirability of a uniform system of naming viruses.

Net-necrosis versus stem-end browning in Aroostook potatoes. A ıer. Potato Journ. **7**(9): 251–256, 1930.

The author discusses these diseases with reference to regions in which the potatoes are grown and varietal susceptibility.

Virus diseases of the potato. Potato Ass'n Amer. 17th Ann. Meeting Proc. **1930**: 83–101, 134–140, 1931.

A review of the recent literature (1928–1930) on the potato virus diseases is given. Considerations are given under different aspects.

Why potatoes run out. New Hampshire Hort. Soc. Ann. Rpt. **19**: 90–98, 1931.

Popular account of the subject.

Potato virus diseases in 1931. Amer. Potato Journ. **9**: 173–181. 1932.

A review of the subject for the year.

Growing seed potatoes under an åster cloth cage. Amer. Potato Journ. March, 1934.

Description and details of an experiment conducted by the author to avoid spread of virus diseases.

Forsteneichner, F[ranz]

Die mosaikkrankheit des Manioks. (The mosaic disease of Maniocs.) Tropenflanzer **35**: 349–350, 1932.

A record.

Fortún Martínez, Gonzalo & Bruner, Stephen C[ole]

Investigaciones sobre la enfermedad del mosaico o rayas amarillas de la caña de azúcar. (Investigations on mosaic or yellow stripe disease of sugar cane) Rev. Agric. Com. & Trab. Cuba 3 441–445, 1921.

The results of a field test with 52 varieties of cane to determine resistance and susceptibility.

El mosaico o rayas amarillas de la caña de azúcar (The mosaic or yellow stripe of sugar cane Rev Agric. Com & Trab. Cuba 6(1) 4–8 1924

¿Cuál es el origen del matizado en Cuba? (What is the origin of mottling in Cuba?) Rev Azucarera (Argentina) No. 374. 1089, 1924

Foster, A[rthur] C[rawford]

"Curl" and its cure Nat Potato Soc. Ann. Rpt. pp 25–29, 1905

Fracanzani, G. A.

Mosaicatura del Tabaco. (Tobacco mosaic) Boll. Tecn. R. Ist. Sperim, Colt Tabacchi "Leonardo Angeloni" Scafati (Salerno) 29(4) 244–247, 1933 (Giornale di Agric. Domenica (Italy) 10(1) 5, 1933)

Description of the disease and his experiments in Salerno, Italy, were it appears very serious. He reports his attempts to control the disease with injections of ferrous sulphate, which seems to be successful.

Fracker, S[tanley] B[lack]

Varietal susceptibility to false blossom in cranberries. Phytopathology 10 173–175, 1920.

A brief discussion of the subject.

Frank, A. B.

Eine neue Kartoffelkrankheit? (Is a new potato disease?) Centralb. Bakt. II 3 403–408, 1897.

Refers to the curl disease of potatoes.

Bemerkungen uber die Krauselkrankheit und verwandte staudenkrankheiten der Kartoffeln. (Observation of the disease of potatoes and related diseases of the stem.) Centralb. Bakt. II. 4: 683–687, 1898.

Frank, Arthur

Mosaic, a serious disease of potatoes. Western Washington Expt. Sta. Bi Mo. Bull. **10**: 64, 1922.

A record of the occurrence of the disease in Washington.

Selection of disease-free berry plants. Western Washington Expt. Sta. Bi Mo. Bull. **10**: 110–111, 1923.

Record of four virus diseases.

Diseases and insect pests of raspberries and their control. Western Washington Expt. Sta. Bi Mo. Bull. **11**: 79–81, 1923.

Facts regarding the mosaic disease of raspberry and loganberry in Western Washington. Western Washington Expt. Sta. Bi Mo. Bull. **12**(2): 48–51, 1924.

A popular discussion of the subject.

1924 information on winter injury, mosaic and other diseases of raspberries in Western Washington. Washington State Hort. Ass'n. Proc. **20**: 128–135, 1924.

A popular discussion of the subject.

Franklin, H[enry] J[ames]

False blossom. Wisconsin State Cranberry Growers' Ass'n. Meeting **41**: 10–17, 1928.

Massachusetts Agric. Expt. Sta. Ann. Rpt. for the Fiscal Year ending Nov. 30, 1930. (Bull. **260**). pp. 345–346, 1930.

Report cranberry false blossom.

Freeman, E[dward] M[onroe]

Report of the Division of Plant Pathology and Botany. Minnesota Agric. Expt. Sta. Rpt. **1920**: 51–53, 1920.

------------, **& Leach, J[ulian] G[ilbert]**

Report of the Division of Plant Pathology and Botany. Minnesota Agric. Expt. Sta. Rpt. **1921**: 74, 1921.

Freeman, W[illiam] G[eorge]

Sugar cane mosaic. Trinidad & Tobago. Administration Report of the Director of Agric. **1922**, 12 p., 1923.

Administration Report of the Director of Agriculture of the Department of Agric. Trinidad & Tobago, **1921**, 12 p., 1922. (Rev. Appl. Mycol. **2**: 394, 1923.)

Refers to campaign for the eradication of mosaic.

Freiberg, G[eorge] W[illiam]

Studies in the mosaic disease of plants. Missouri Bot. Gard. Ann. Rpt. **4**(2): 175–232, 1917.

A lengthy paper giving results of microchemical studies to determine difference in chemical elements in diseased and healthy plants. Also studies on physiological relations, plot experiments, temperature, moisture and light relations, methods of transmission and a discussion of recent investigations.

Freise, F[riedrich] W.

Cane diseases and plagues in Brazil. Mosaic, sereh, iliau disease and gummosis are the most prevalent.—low yields attributed largely to losses caused by these agents. Facts About Sugar **25**(24): 613–614, 1930.

A popular discussion of cane diseases in Brazil.

Freitag, Julius H., & Severin, H[enry] H[erman] P[aul]

List of ornamental flowering plants experimentally infected with curly top. U.S.D.A. Plant Disease Reporter **17**(1): 2–5, 1933.

Experiments of transmission of curly-top disease of sugar beet by the leafhopper *Eutettix tenella*. It was tried on 90 species of ornamental flowering plants which include 72 genera and 33 families. A list of the artificially infected plants is inserted.

Froberville, L. F. de

Degeneration of the Uba Cane. South Africa Sugar Journ. **7**: 303–305, 1923.

Fromme, F[red] D[enton]

Diseases of cereal and forage crops in the United States in 1920. U. S. D. A. Br. Plant Indus. Plant Disease Bull. sup. **15**: 173, 1921.

------------, **Wingard, S[amuel] A[ndrew], & Priode C[arl] N[oel]**

Ring spot of tobacco; an infectious disease of unknown cause. Phytopathology **17**(5): 321–328, 1927.

A description of the diseased plants and the results of infection experiments.

Fukano, Hiroshi

Effects of tobacco mosaic upon the growth of *Bac. aroideae* Townsend the cause of tobacco hollow stalk. Bulteno Scie. Fajutl. Terkult. Kjusu Imp. Univ. Fukuoka, Japan **4**(1): 45–51, 1930.

(A Japanese paper with English summary.) The juice from mosaic plants was passed through a Berkefeld filter and put in Czapek's solution. It accelerated the growth of the bacteria.

Fukushi, Teikichi

(On the mosaic of tobacco.) Journ. Plant Prot. **14**(4): 217–232, (5)269–276, (6)333–339, (7)385–392, 1929.

The author gives a review of the literature, describes the symptoms and the pathological anatomy, gives the host range and the nature of the virus.

(On the cause of the tobacco mosaic disease.) Agric. Hort. **4**(11): 1273–1283, 1929

A review of the subject.

Effects of certain alkaloids, glucosides and other substances upon the infectivity of the mosaic tobacco juice. Trans. Sapporo Nat. Hist. Soc. **11**(2): 59–69, 1930. (A Japanese paper with English summary.)

The author gives the results of a series of experiments which demonstrate that tobacco virus is very resistant to many chemicals.

Aster yellows in Japan. Agric. & Hort. **5**: 577–584, 1930.

No parasitic organism accounting for the disease has been found.

On the mosaic disease of broad beans. Journ. Plant Protect. **17**(11): 707–712. 1930. (12): 779–784, 1931.

The author discusses the host range, symptom, etiology and transmission of the disease.

(On the modes of tranmission of the mosaic disease of tobacco.) Journ. Sapporo Soc. Agr. & For. **22**(102): 305–320, 1931.

The author discusses the methods of transmission and says that the virus was obtained in 25 out of 30 packages of commercial tobacco.

On the intracellular bodies associated with the dwarf disease of rice plant. Trans. Sapporo. Nat., Hist. Soc. **12**(1): 35–41, 1931.

A contribution to our knowledge of virus diseases of plants in Japan Trans Sapporo Nat Hist Soc **12**(2–3) 130–141, 1932

A general review of the virus diseases in Japan There are 71 species, included in 51 genera and 15 families The new ones are *Primula obconica, P denticulata, Crotalaria juncea, Iris pumila,* and *I tectonum,* carnation and lilies

On some properties of the tobacco mosaic virus Japan Journ Bot **6**(3) 381–392, 1933.

A review of this phase of the subject and the results of the author's recent studies Tobacco mosaic virus was absorbed by kaolin and alumina The virus was most virulent at Ph 4–7

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Transmission of the virus through the eggs of an insect vector Proc Imperial Acad **9**(8) 457–460, 1933

The author demonstrated that the virus of the dwarf disease of rice could be transmitted by *Nephotettix apicalis* hatched from eggs of virulent parent, without the young feeding on diseased plants. This is the first record of transmission through the eggs

Fuller, C.

Mealie variegation First Report Government Entomologist Natal 1899 1900 17 19 1901

This is the first record describing streak disease of sugar cane

Fulmek, L[eopold]

Pelargonien–Krauselkrankheit (Pelargonium–Curl disease) Oesterr Gartenztg **12** 112–115 1917

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Ueber im Jahre 1920 erschienene bemerkenswerte Mitteilungen auf dem Gebiete der tierischen und pflanzlichen Feinden der Kartoffelpflanze (Note worthy contributions published during 1920 to the study of insect and vegetable pests of the potato) Centralblatt fur Bakt, Abst 2 Lief **54** (20–24); 492–529 1921

Funaoka, S[eigo]

Beitrage zur Kenntnis der Anatomie panaschierter Blatter. (Contribution to the knowledge of the anatomy of variegated leaves) Biol Zentralbl **44** 343–384, 1924

Gadd, C[aleb] H[erbert]

Observations on the plot of plantains affected by the bunchy top disease at Paradeniya. Ceylon Dept. Agric. Yearbook **1925**: 36–37, 1927.

A record of testing varieties. None of them are resistant.

Bunchy top disease of plantains. Trop. Agric. (Ceylon) **66**(1): 3-9, 1926.

A general discussion and geographical distribution.

Gaget, J.

La dégénérescence des pommes de terre. (Degeneration of potatoes.) Journ. Agric. Pract. **35**: 316–318, 1921.

The author discusses the relation of insects to the disease and the difficulty of eliminating them.

Gandía Córdova, Ramón

La enfermedad de la caña. (The disease of sugar cane.) Rev. Agric. Puerto Rico. **3**(1): 63, 1919.

Popular account discussing the occurrence of the disease in Puerto Rico.

Garbowski, L[udwik]

Choroby virusove Ziemniaków w okrésie 1928–1932. (Virus diseases of potatoes during the period from 1928 to 1932.) Prace Wydz. Chrób Róslin Panstw. Inst. Naukow, Gospod. Wiejsk. w Bydgoszcy (Trans. Phytopath. Sect. State Inst. Agric. Sci. in Bydgoszcfi), **13**: 3–136, 1933.

The author divides this article in two parts. Part I is a review of the more recent developments in the study of potato degeneration, analyzing the two tendencies, one towards the virus principle and the other towards physiological causes. In the second part he presents a very comprehensive, detailed and tabulated account of his field observations of potato varieties from Poland, Germany, England and Holland.

Garcke

Zur Blattrollkrankheit. (Leaf-roll disease.) Die Kranke Pflanze. **3**: 41–42, 1926.

Gard, M[edéric]

Sur la chlorose de noyer cultivé. (Chlorosis of cultivated walnut.) Rev. Path. Vég. & Ent. Agric. **3**: 264–266, 1926.

Gardner, Max W[illiam,] & Kendrick, James B[lair]

Soybean mosaic. Journ. Agric. Res. **22**(2): 111–114, 1921.

Original description and results of inoculation experiments.

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Turnip mosaic. Journ Agric. Res. **22**(3): 123–124, 1921.

Original description and results of inoculation experiments.

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Overwintering of tomato mosaic. Bot. Gaz. **73**(6)469-485, 1922. (Phytopathology (Abstract) **12**(1): 15, 41–42, 1922.)

Evidence indicating that the disease overwinters in several species of *Physalis*.

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Tomato mosaic. Indiana Agric. Expt. Sta. Bull. **261**, 24 p., 1922

Gives history, distribution, losses, susceptibility, related plants, symptoms and spread.

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Field control of tomato mosaic. Phytopathology **13**(8): 372–375, 1923.

Gives results of control of the disease by the eradication of virus carrying weeds *Physalis subglabrata* and *Solanum carolinense* are the most important.

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Potato leaf-roll in Indiana. Indiana Agric. Expt. Sta. Bull. **284**, 23 p., 1924.

Gives the results of yields based on experimental plantings. Also discusses spread, immune varieties and methods of control.

Department of botany report Indiana Agric. Expt. Sta. Ann. Rpt **1924**: 13–20, 1924.

Reports that potato leaf roll reduced yield from 38 to 66 per cent. Also new evidence has been obtained that a very destructive streak (winter blight) of tomatoes is a severe manifestation of mosaic.

Hyperplastic crushing of the tracheal tubes in mosaic tomato stem. Phytopathology **15**(12): 759–762, 1925.

A very interesting paper on histological studies.

Necrosis, hyperplasia and adhesions in mosaic tomato fruits. Journ. Agric. Res. **30**(9): 871–888, 1925.

A very interesting paper on histological studies.

Indiana plant diseases, 1925. Indiana Acad. Sci. Proc. **36** (1926): 231–247, 1927.

Notes on virus diseases of bean, *Trifolium arvensis*, *T. subterraneum*, *T. incarnatum*, *T. resupinatum*, cow-pea, eggplant, pepper, tomato and velvet bean.

---------, & **Kendrick, James B[lair]**

Potatoes.—A virus disease menace to tomatoes. Hoosier Hort. **9**(1): 5–16, 1927.

A popular discussion.

Potato mosaic and leaf-roll: Spread and effect on yield. Trans. Indiana Hort. Soc. p. 158–168, 1928.

This paper gives valuable data based on field studies.

Gates, R. R[uggles]

Ultramicroscopic organisms of filterable viruses. Nature **11** (2950): 692, 1926.

Gaylord, F[ay] C[laude,] & Gregory C[harles] T[ruman]

More and better potatoes. Indiana Agric. Expt. Sta. Bull. **89,** 24 p., rev., 1923.

Geerts, J[ohannes] M[arinus]

I et optreden van Strepenziekte in den westmoeson van 1923-1924. (The occurrence of stripe disease in the west monsoon of 1923–1924.) Arch. Java Suikerind. **46**: 1295–1331, 1924. (Rev. Appl. Mycol. **4**: 244–245, 1925. Facts About Sugar **20**(2): 34, 1925.)

This is a discussion of the status of the mosaic (not stripe) of sugar cane in Java at the present time. The paper contains much statistical data.

Gertz, O[tto Daniel]

Makrokenieska ägghivileprof a blad. (Macrochemical test ot leaves.) Bot. Not. **1917**: 1–35. (Zeitschr. Pflanzenk. **29**: 51–52, 1919.)

Ghesquiere, J[ean]

Sur la "mycosphaerellose" des Feuilles du manioc. (On mycosphaerellosis of cassava leaves.) Bull. Inst. Roy. Colon. Belge **3**(1): 160–178, 1932.

In a foot note to this paper the author states that the carrier of mosaic is an Aleurodid,—*Bemisia mosaicivecto* n. sp.

Ghimpu, V.

Bolile cu virus ale Tutunului. (Virus diseases of tobacco.) Bul. Cultivarei si Fermentarei Tutumului. Bucarest **21**(2): 163-214, 1932.

Detailed account of the author's field observations based on controlled experiments of four virus diseases of tobacco occurring in Rumania. These are: mottled mosaic, ring spot, veinbanding and spot mosaic. A bibliography of 120 titles is appended. The author also considers his inoculation experiments and cytological studies of diseased tobacco plants.

Afectuinile patologice si inamicii Tutunului din Romania in 1932. (Pathological troubles and pests of tobacco in Rumania during 1932.) Bull. Cultivarei si Fermentarei Tutunului, Bucarest. **21**(4) : 9, 1932.

Notes on virus diseases of tobacco occurring in Rumania.

Sur les maladies á virus de quelques Solanées. (On the virus diseases of some Solanaceae.) Compt. Rend. Soc. Biol. **112** (11) : 1113–1115, 1933.

List and description of some Solanaceous plants which have been found affected with virus diseases in Rumania, description and classification of the diseases.

Giddings, N[ahum] J[ames,] Allard, H[arry] A[rdell] & Hite, B[ert] H[olmes]

Inactivation of the tobacco-mosaic virus by high preassures. Phytopathology **19**(8) : 749–750, 1929. (Rev. Appl. Mycol. **9** (2) : 138, 1930.)

No infection occurred with juice subjected to a pressure of 130,000 pounds. The enzyme zymase was inactivated at a lower pressure.

Gigante, R[oberto]

Ricerche preliminari sopra un' alterazione non parassitaria delle olive. (Preliminary researches on a disorder not parasitic of the olive.) Rendic. R. Accad. Lincei. 17, **6**(1) : 99–103, 1933.

Gilbert, A[lfred] H[olley]

Correlation of foliage degeneration diseases of the Irish potato with variations of the tuber and sprout. Journ. Agric. Res. **25**(6) : 255–266, 1923.

Gives the results of studies whereby the author was able to correlate symptoms of certain diseased on certain varieties.

Spindle tuber and giant hill. Potato News Bull. **1** : 291–292, 1924.

These two diseases are definitely recognised.

Studies on spindle tuber of potato. Potato Ass'n. Amer. Proc. 1924 Ann. Meeting **11**: 101–102, 1925.
A popular discussion of the subject.

"Giant hill" potatoes a dangerous source of seed: A new phase of spindle tuber. Vermont Agric. Expt. Sta. Bull. **245**, 16 p., 1925
This paper gives symptoms and method of control.

Net-necrosis of the potato. Phytopathology **17**(8): 555–561, 1927.
Several types of necrosis are found in potatoes. One is definitely associated with leafroll.

Net necrosis of the potato tuber. Amer Potato Journ. **4**(8): 90–92, 1927.
Popular discussion.

Production of potato tuber necrosis. Science **67**(1740): 464–465, 1928.
The author grew healthy and leafroll potatoes in cages. *Myzus persicae* was colonized on diseased plants and then transferred to the healthy plants. When the potatoes were harvested, the healthy plants were found to show phloem necrosis.

Net-necrosis of Irish potato tubers Phytopathology (Abstract) **19**(1): 82, 1929.

Net-necrosis of Irish potato tuber. Vermont Agric. Expt. Sta. Bull. **289**, 36 p., 1928. (Rev. Appl. Mycol. **9**(7): 476, 1930.)
The author gives a review of the literature, a description of the disease and a very lengthy study of the histology.

Gilbert, W[illiam] W[illiams]

Cucumber mosaic diseases. Phytopathology **6**(2): 143–144, 1916.
A brief statement giving the distribution of the disease.

Cucumber diseases in the Middle West. Phytopathology (Abstract) **6**(1): 104–105, 1916.

Gloyer, W[alter] O[scar]

Effect of straw mulch on potato leaf-roll. Phytopathology (Abstract) **10**(1): 60, 1920.

Goddard, E[rnest] J[ames,] Magee, C[harles] J., & Collard, H.

Bunchy top in bananas, (12) Queensland Agric. Journ. **24**(5): 424–429, 1925. (Fruit World Australasia 25: 519–522, 1925.)

The disease is carried by an Aphid, *Pentalonia nigro-nervosa*. The sieve tubes undergo modifications.

Bunchy top in bananas: Final report of investigation committee. Queensland Agri. Journ. **25**(6): 506–510, 1926.

Bunchy top of bananas. Journ. Council Sci. & Indus. Res. (Australia) **2**(1): 24–27, 1929.

The disease attacks all species of bananas and Manila Hemp, but has not been found on any plants other than species of Musa. The author describes the symptoms and gives suggestions for its control.

Virus diseases of plants. Nature **40**(1): 1929.

Virus diseases and their bearing on the cell theory and other biological concepts. Proc. Roy. Soc. Queensland **40**(1): 2–12, 1929.

Gold, T[heodore] S[edgwick]

Report of Commissioner on peach yellows. Connecticut Board of Agric. Sec. Rpt. **1896.**

Gives a discussion with special reference to legal regulations.

Golding, F. D.

A vector of leaf curl of cotton in Southern Nigeria. Empire Cotton Growing Rev. **7**(2): 120–126, 1930.

Reports of experiments to determine insect vectors of "leaf curl" of cotton. It was found an unidentifield *Aleurodid* is able to transmit leaf curl in cotton.

Goldstein, Bessie

Cytological study of living cells of tobacco plants affected with mosaic disease. Bull. Torrey Bot. Club **51**(6): 261–273, 1924.

A study of the living cells of mosaic tobacco plants in which she describes the movements of the intracellular bodies.

A cytological study of the leaves and growing points of healthy and mosaic tobacco plants. Bull. Torrey Bot. Club **53**(8): 499–599, 1926.

This paper gives a review of the literature, the symptoms of the disease, a discussion of the strains of mosaic, methods of transmission, symptomless carriers, filtration and other properties of the virus, influence of environment on symptoms and a very thorough study of the histology and cytology of diseased plants.

The X bodies in the cells of dahlia plants affected with mosaic disease and dwarf Bull Torrey Bot Club **54**(4): 285–293, 1927 Phytopathology (Abstract) **17**(1) 52, 1927

This paper gives a discussion of the X bodies found in dahlia.

Nuclear form as related to funtional activities of normal and pathological cells Bot Ga **86**(4) 365 383, 1928.

A discussion of the effects of the disease on the nuclei.

Goldsworthy, M[arion] C.

Attempt to cultivate the tobacco mosaic virus Phytopathology **16**(11) 873 875, 1926

The author duplicated the work of Olitsky but the virus did not increase in the culture

Gontiére, J. F.

Sur quelques maladies du tabac. (Some tobacco diseases.) Journ Agric Pract **64** 659–571, 1900 (Rev. Centralbl. f. Bk. 7 733 1901.)

Goot, P[ieter] van der

Overzicht der voornaamste ziekten van het aardappelgewas in Java (Survey of the principal disease of the potato in Java.) Inst Plantenziekten Bull **18**, 42 p, 1924.

Aanteekening over aadappelcultuur en virusziekten in Ned Indië. (Plans on potato culture and virus diseases in Ned India.) Tijdschr Plantenziekten **31** 167–178, 1925

Goseco, A[ndres] P.

The transmission of the Fiji disease of the sugar cane Sugar News **7**(10) 736 739, 1926

Goss, R[obert] W[hitmore]

Effect of environment on potato degeneration diseases. Nebraska Agric Expt Sta Bull **26**, 40 p., 1924.

This is a very thorough discussion of symptoms with reference to environments, based on field tests

————, & Peltier, Geo[ge] L[eon]

Further studies on the effect of environment on potato degeneration diseases Nebraska Agric Expt Sta. Bull **29**, 32 p., 1925.

Field studies devoted largely to the influence of climatic factors on the symptoms of the various diseases.

Effects of spindle tuber disease on sprouting. Potato News Bull. **2** 261–262, 264, 1925.

Diseased tubers sprout later than healthy tubers. Sometimes the diseased tubers fail to produce plants but form tubers from the seed piece.

A simple method of inoculating potatoes with spindle tuber disease Phytopathology **16**(3): 233, 1926.

The author's work shows that the disease can be transmitted in this manner. The loss in the next crop was 52 per cent.

Transmission of potato spindle tuber by cutting knives and seed piece contact Phytopathology **16**(4): 299–304, 1926.

This paper gives the results of experiments which indicate that the disease may be transmitted by cutting knives and by contact with freshly cut seed pieces.

Transmission of potato spindle tuber by grasshoppers. (Locustidae) Phytopathology **18**(5): 445–488, 1928 (Phytopathology (Abstract) **18**(1) 140 1928)

The author presents evidence that the disease is carried by grasshoppers He believes that the importance of the aphids has been over estimated.

The rate of spread of potato virus diseases in Western Nebraska. Journ Agric Res **39**(1): 83–74, 1929. (Rev. Appl. Mycol. **9** (1) 51 52, 1920)

This paper gives very interesting field data from field experiments with several virus diseases.

Insect transmission of potato virus diseases Phytopathology (Abstract) **20**(1) 136 1930

Spindle tuber and unmottled curly dwarf were transmitted by grasshoppers (*Melanoplus* sp) flea beetle (*Epitrix cucumeris* and *Systena elongata*), the tarnish plant bug (*Lygus pratensis*) and the Colorado potato beetle (*Leptinotarse decemlineata*). The spindle tuber was transmitted by the leaf beetle (*Disonycha triangularis*).

The symptoms of spindle tuber and unmottled curly dwarf of the potato. Nebraska Agric Expt. Sta Res Bull. **47**, 39 p., 1930

The author gives a review of the literature and a discussion of symptoms with reference to environment. The symptoms are modified in plants grown under glass and tuber symptoms increase under high soil moisture content and under high soil temperatures.

Infection experiments with spindle tuber unmottled curly dwarf of the potato. Nebraska Agric. Expt. Sta. Res. Bull. **53**, 36 p., 1931.

Field experiments and observations are discussed by the author.

Gounaux, C[laude] B[ernard]

Mosaic disease of sugar cane in Louisiana Louisiana Planter **65** 269, 1920

Recommendations for roguing

Sugar cane test field work Louisiana Agric Expt Sta. Bull. **202**, 32 p, 1928 (Rev Appl. Mycol. **7** 741, 1928)

A report on varieties resistant to mosaic and other diseases.

Gowdey, C[arlton] C.

Relationship of insects to mosaic disease of sugar cane. Jamaica Dept Agric Ann Rpt **1924**·19–20, 1924 (Rev. Appl. Ent. ser A **12** 442–445, 1924.)

Grainger, J[ohn]

An infectious chlorosis of the dock (*Rumex obtusifolius.*) Leeds Phil Soc Sci Sect **1**(8) 360, 1928.

An attempt to cultivate the virus of tobacco mosaic *in vitro* Leeds Phil Soc Sci Sect Proc. **2**(1): 33 35, 1929. (Rev. Appl. Mycol **9**: 564, 1930.)

The appearance of bean mosaic in England. Leeds Phil. Soc. Sci. Sect Proc. **2**(1): 32, 1929.

The first record of this disease in England.

---------, **& Cockerham, G.**

Some properties of the virus extract of dock mosaic. Leeds Phil Soc. Sci. Sect. **2**(3): 120–124, 1930.

Procedure of experiment is explained. Although these results did not afford conclusive proof that the cause of chlorosis in docks is a virus, they are considered sufficient to justify the provisional classification of this disturbance among this group of diseases. *Rumex obtusifolius* and *R. lanceolatus* were studied and observed.

---------, **& Angood, Edith**

The insect transmission of raspberry mosaic. Leeds Phil. Soc Sci. Sect. Proc. **2**(4): 183–184, 1931.

Conclusions were reached by the authors as to capability of *Aphis rubiphila* in transmitting raspberry mosaic in England.

The movement of tobacco mosaic virus in its host. Ann. Appl. Bio. **20**(2): 236–257, 1933.

Extensive work explaining his experiments on the subject.

--------------, & **Heafford, Rachel M.**

Some effects of the ordinary tobacco mosaic upon the developmental anatomy of the host plant. Proc. Leeds Phil. Soc. Scient. Sect. **2**(9): 406-415, 1933.

Brief report of the results obtained by the authors' studies of the effect on the developmental anatomy of tobacco leaf of Johnson's No. 1 virus or ordinary tobacco mosaic.

Virus diseases of plants. Oxford Univ. Press. 104 p., 1934.

A brief but very complete discussion of our knowledge of virus diseases up to date in which the author includes methods of work.

Gram, Ernst

Kan vi kontrollere os fra Bladrullesygen. (Can potato leaf roll be controlled by inspection?) Vort Landbrug (Copenhagen) **41**: 416–417. 1922.

The author urges the use of localities as "sanatoria" and the practice of rigid inspection.

Forsog med oalsstedets indflydelse paa kartoffelens bladrullesyge. (Potato leaf roll influenced by the origin of the tubers.) Tidsskr. Planteavl **23**: 769-806, 1922. (Int. Conf. Phytopath. Holland p. 38-39, 1923.)

A review of our knowledge of this disease with the results of field experiments. The author reports that the disease was less prevalent when May and June were cool and moist.

Einfluss des Anbauortes auf die Blattrollkrankheit der Kartoffel. (Influence of local conditions on the leaf roll disease of potato.) Angew. Botanik **5**(1): 1–20, 1923.

--------------, & **Rostrup, Sofie**

Oversight over Sydomme hos Landbrugets og Havebrugets kulturplanter i 1922. (Survey of the diseases of cultivated agricultural and horticultural plants in 1922.) Tidsskr. for Planteavl **24**(2): 236–307, 1923.

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Oversight over Sydomme hos Landbrugets og Havebrugets Kulturplanter i 1923. (Survey of the diseases of cultivated

agricultural and horticultural plants in 1923.) Tidsskr. Planteavl. **30**(3) 361–412, 1924

Mosaikeyge i Drivhusene (Mosaic diseases in greenhouses.) Gartner Tidende 8 p, 1924

Mosaikeyge i Rodfrugterne (Mosaic in root crops) Vort. Landbrug **43** 181–184, 1924

Records of occurrence and discussions

Mosaikeyge hos Korsblomstrede. (Mosaic in crucifers.) Dansk. Fravl, Kobenhavn (Abstract) **8** 41 42, 1925

Granovsky, A[lexander] A[nastacievitch]

Alfalfa "yellow top" and leafhopper (*Empoasca fabae*) Journ. Econ Ent **21**(2) 261 267, 1928.

This disease appears to be due to a virus but the proof is not positive It is associated with the common potato leafhopper *Empoasca fabae*

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Differentiation of symptoms and effect of leaf hopper feeding on histology of alfalfa leaves Phytopathology (Abstract) **20** (1) 121, 1930

Grant, Theodore J.

The host range and behavior of the ordinary tobacco mosaic virus Phytopathology **24**(1) 311 336, 1934

Based on experiments the author states that the host range of the ordinary tobacco mosaic virus has been extended to include 29 species, representing 14 widely separated families It was generally regarded as limited to certain species of the *Solanaceae* In the non solanaceous hosts the symptoms are marked by variations from masked symptoms to typical chlorosis, mottling, malformations, necrosis and stunting The distribution of the virus also varies The author describes also the behavior of the virus in those non solanaceous host Also gives account of intracellular bodies associated with ordinary mosaic virus established cytologically.

Gratia, A.

Pluralité antigénique et identification sérologique des virus de plantes (Antigenic plurality and serological identification of plant viruses.) Compt Rend. Soc. Biol **114**(35) · 923–924, 1933.

The author followed Purdy's serological experiments with tobacco mosaic. He gives briefly but comprehensively the results obtained from which he concluded that the antigenic plurality of plant viruses is evident.

Qualité antigénique des virus des plantes et des bactériophages. (The antigenic quality of plant viruses and bacteriophages.) Compt. Rend. Soc. Biol. **114**(35): 925–926, 1933.

Based on the results obtained in the preceding experiments the author gives his observations as to the antigenic qualities of the virus under studies. He also calls attention to the analogies between tobacco mosaic and the bacteriophage which he is likewise inclined to refer to exogenous agency.

Identification sérologique et classification des virus des plantes. Distinction entre l' antigene mosaïque et l' antigéne vegétal. (Serologic identification and classification of plant viruses. Distinction between mosaic and plant antigen.) Compt. Rendus. Soc. Biol. (Paris) **115**(11): 1239–1241, 1934.

Gratz, L[evi] O[tto,] & Schultz, E[ugene] S[chultz]

Observations on certain virus diseases of potatoes in Florida and Maine Amer. Potato Journ. **7**(8): 187–200, 1930.

The symptoms and results of these diseases are practically the same in the two places.

Diseases and climate pertaining to the Florida and Maine sections. (Potato virus diseases.) Phytopathology **20**(4): 267–288, 1930.

Transmission of spindle tuber of potatoes through the usual commercial practices. Proc. Potato Assoc. Amer. 1930. **17**: 73–82, 1931.

Gravier, Gabriel

Conferencia pronunciada por el Dr. Carlos E. Chardon, Comisionado de Agricultura de Puerto Rico en la Estación Experimental Agronómica sobre la enfermedad del mosaico o matizado de la caña de azúcar. (Conference delivered by Dr. Carlos E. Chardon, Commissioner of Agriculture of Porto Rico in the Agricultural Experiment Station on "mosaic" or "mottling" disease of sugar cane.) Rev. Agric. Com. & Trab. Cuba **7**(8): 29–32, 1925.

Green, Samuel B[owdlear]

Leaf curl of raspberry. Minnesota Agric. Expt. Sta. Rpt. p. 230, 1894.

Gregory, C[harles] T[ruman,] & Hansen, A[lbert] A[ugust]

Cucumber and muskmelon mosaic Market Growers **31** 180, 1922

Popular

Grey, Robert M[elrose]

The new cane disease in Cuba Louisiana Planter **63**(6) 90, 1919

The author states that the 'yellow stripe'' has been known in Cuba for eighteen years, that infected cuttings frequently produced healthy plants and that the disease has not caused injury It appears to be influenced by weather

Sobre la enfermedad del matizado en la caña (On sugar cane mosaic disease) Rev Azuc. & Agric **1**(6) 132–134, (7): 157–160, 1921 (Louisiana Planter **63** 199 1921)

The author states that the disease which he has been studying is the "yellow stripe" and that,—Climatic conditions have a direct influence on the appearance, diminution and self eradication of mottling chlorosis on field plants During moist, wet, warm weather when growth action is rapid it is more readily expelled

Griffiths, David

Daffodils U S D A Circ **122**, 73 p 1930

Under "diseases" a group of conditions known as "broken" is mentioned which comprises, mottling, mosaic, yellow stripe, grey disease, etc, some of which are believed to be due to a virus

Grieve, B. J.

"Rose wilt" and "die back" A virus disease of roses occurring in Australia Australia Journ Expt Biol & Med Sci. **8** (2) 107 121, 1931

A description of a disease that can be transmitted by filtered juice.

Groene, F. de

Verschil in toeneme in het percentage mosaikziekte bij Eigenheimers, verbouwd op zware Klei en lichte zavelgrond. Tijdschr Plantenziekten **36**(1) 13–16, 1930

The experiment showed that potato mosaic is more easily transmitted in sandy soil than in heavy loams

Mededeelingen over proeven met Eigenheimer in den Wilhelminapolder met betrekking tot de verbreiding der mozaiekziekte Landbouwk Tidschr **42**(509) 553–561, 1930.

Grove, A[rthur]

Diseases of lilies Gard Chron **81** 178–179, 197–199, 1927.

The diseases of lilies. Gard Chron. **86**: 10, 1929.

The diseases of lilies Gard Chron. **88**(2290)408–409, 1930.
The author calls the attention to the probability that the mosaic disease of lilies is found in the Japanese imported stock

The diseases of lilies Gard Chron **89**(2302) 110, 1931
Short article giving explanatory notes on a series of photographs received by the author and calling the attention to the alarming increase of mosaic on lilies from imported stock from Japan

Grubb, N H., & Massee, A. M.

Raspberry mosaic East Malling Res Sta Kent, Ann Rpt. **1923** 131–133 1924

Guba, E. F.

Strawberry gold disease Massachusetts Agric Expt Sta. Ann Rpt (Bull **280**) **1931** 204 1932
The author reports a disease transmitted by the seed with marked stunting and necrosis, characteristics of a virus disease Vegetative propagations acquired the disease

"Suspected mosaic of the strawberry Phytopathology **23** (8) 654–661, 1933
The author reports a disease on strawberries named "gold leaf" in Massachusetts and restricted to the Howard 17 variety The same disorder is designated as "suspected mosaic" by Berkeley and "non infectious chlorosis" by Clark It is evidently identical with the chlorosis, yellows or xanthosis studied by Plakidas The author concludes with a description of the disease and his observations on transmission.

Gulyás, Antal

A dohany level márvásyozott foltossaga (panaschirozottsága) és a mozaik (A chlorosis of tobacco leaves and the mosaic disease) Kiserletugyi Ko zlemények **31**(3) · 261–273, 1928.
The author describes a chlorosis which is not a virus disease and compares it with mosaic.

Untersuchungen uber die Blattfleckenkrankheiten des Tabaks. (Investigations about the leaf spot diseases of tobacco) Jahrb. K. ung. Land. Akad Debrecen **1928** 20–24, 1928.

Güssow, H[ans] T[heodor]

Leaf-roll in tomatoes. Phytopathology **6**(6) 447, 1916.
A leaf roll similar in appearance to the leaf-roll of potatoes.

Observations on obscure potato troubles Phytopathology **8** (9) 491 495 1918

In Part III potato streak disease of potato is discussed Streaks are similar to those sometimes found in mosaic but no connection was found between the two diseases No organism was found. In Part II potato mosaic could not be transferred by contact but was transmitted by inarched graft

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Bean mosaic Canada Dept Agr Expt Farms Interim Rept. of Bot **1921–22** 26-27 1922

Gutermann, C[arl] E[dward] F[rederick]

A preliminary report on mechanical transmission of the mosaic of *Lilium auratum* Phytopathology **18**(12) 1025 1026 1928

A description of methods

The lily disease investigation fellowship Hort Soc New York, Yearbook p 34–37 1929

Diseases of lilies For the lily diseases investigations fellowship Hort Soc New York Yearbook **1930** 51–152, 1931 (Final summary of the work on diseases of lilies Boyce Thompson Inst Prof Paper **1**(19) 146–197 1931)

A part of these papers is devoted to the mosaic disease First record by Stewart in 1896 Description of symptoms pathogenicity, transmission by *Aphis gossypii* and control.

Haas, A[lbert] R[ichard] C[arl] Batchelor, L[eon] D[exter] & Thomas, E[llis] E[dward]

Yellows or little leaf of walnut trees Bot Gaz **86**(2) 172 192, 1928

This disease is not infectious and there is no proof that it is due to a virus.

Hach, Otto

Cane varieties mosaic disease and fertilizers in the West Indies. Facts About Sugar **25**(16) 377–379, 1930

Popular discussion on fertilizer suggesting the use of potash to control mosaic disease on sugar cane

Haddon, F. C

Cane mosaic and insects Hawaiian Planters' Rec **32**(1): 130–142, 1928, (Rev Appl Mycol **7** 742–743, 1928, Facts About Sugar **23**(32) 758–759, 1928

The author transmitted mosaic to 22 different species of grasses and obtained different characteristics

Haegele, R. W.

The beet leaf-hopper (*Eutettix tenellus* Baker): a survey in Idaho. Idaho Agric. Expt. Sta. Bull. **156,** 28 p, 1927.

This paper does not contain any discussion of a virus disease but is of interest because of the relation of the insect to sugar-beet curly-leaf disease.

Field studies of the beet leafhopper *Eutettix tenellus* Baker. Idaho, Agric. Expt. Sta. Bull. **182,** 51 p., 1932.

This paper does not deal with a virus disease but is of value because this insect is a vector for the curly leaf of sugar beet.

Hall, A. D[aniel]

The breaking of tulip species. Gard. Chron. **85**(2215): **423,** 1929.

Virus diseases of plants. Gard. Chron. **91**(2364): 293–294, 1932.

Brief account on virus diseases of garden plants, more especially on Monocotyledonous among which are mentioned: tulip, gladiolus, freesia, lily, iris, crocus, *sternbergia,* and narcissi.

The transmission of tulip breaking. Gard. Chron. **93**(2420): 330–331, 1933.

Report of experiments in tulip breaking transmission by means of insect vectors. The insects used were *Mysus persicae, Macrosiphum gei* and *Anuraphis tulipae.*

Hall, C[onatant] J[ohan] J[acob] van

Ziekten en plagen der cultuurgervassen in Nederlandsch Indie in 1922. (Diseases and pests of economic plants in the Dutch East Indies in 1922.) Meded. Inst. voor Plantenziekten **58,** 42 p., 1923.

Ziekten en plagen der cultuurgervassen in Nederlandsch Indie in 1923. (Diseases and pests of economic plants in the Dutch East Indies in 1923.) Meded. Inst. voor Plantenziekten, **64,** 47 p., 1924.

Nine neue Kaffee–Krankheit in Nederländisch–Indien. (A new coffee disease in the Netherland Indies.) Intern. Landw. Rundschau p. 864, 1928.

Phloem necrosis of coffee.

Halle, T[hore] G[ustafson]

On leaf-mosaic and anisophylly in paleozoic equisetale. Svensk. Bot. Tidskr. **22**: 230–235, 1928.

Hallier, E.

Die Ursache der Kräuselkrankheit. (The cause of curl disease.) Zeitschr. Parasitenk. **4**(2): 48, 1875.

Historical value only.

Die Kräuselkrankheit der Kartoffeln. (The curl disease of potato.) D. Landw. Presse 79, 86, 87, 1876.

Historical.

Hamann

Die Blattrollkrankheit der Kartoffeln. (The leaf roll disease of potatoes.) Hess Landw. Zeitg. **81**: 311, 1911.

Hamblac, H.

La mosaïque de la canne á sucre. (The mosaic of sugar cane.) Journ. Stat. Agron. Guadeloupe **3**: 86–91, 1923.

Hamblin, Charles O[swald]

Spotted wilt of tomatoes. Agric. Gaz. New S. Wales **32**(**1**): **50**, 1921.

The disease appears to be infectious but the method of transmission has not been observed.

Overwintering of spotted wilt of tomatoes. Agric. Gaz. of New South Wales. **32**(8): 547, 1921.

A brief statement that this disease is carried through the winter in old plants.

Hamilton, Marion A.

Notes on the culturing of insects for virus work Ann. Appl. Biol. **17**(3): 487–492, 1930.

The author gives a method for keeping pure and uninfected cultures of aphides for virus work.

On three new virus diseases of *Hyoscyamus niger*. Ann. Appl. Biol. **19**(4): 550–667, 1932.

They are described as Hy. I, Hy. II, Hy. III, Hy. IV. They occur on other solanaceous plants including the potato. Hy. II, Hy. III, will not pass through a Chamberland or L-3 filter but are transmitted to all hosts, except tomato, by *Mysus persicae*.

Hanken, H. A.

Verslag van de proefneming gedaan in "De Wilhelminapolder" in verband met den achteruitgang van aardappel-ppotgved afkomstig van gelipke afstamming in een streck maar op verschillende grondsoort. Tijdschr. Plantenziekten **31**: 163–165, 1925.

Hansford, C[lifford] G[erarld]

Sugar and mosaic disease of cane. Journ. Jamaica Agric. Soc. **27**(8): 865–869, 1923.

History and description of the disease. Methods of transmission and control.

The mosaic disease of sugar cane. Jamaica Dept. Agric. Microbiol Circ. **2**, 14 p., 1923.

A very complete popular discussion of this disease.

Mosaic disease of canes. Journ. Jamaica Agric. Soc. **27**: 961–964, 1923.

The author discusses the spread of the disease, methods of eradication and the results of experimental work.

Forms of mosaic disease. Journ. Jamaica Agric. Soc. **29**(1): 13-14, 1925.

A brief statement of different types of chlorotic diseases. A paper read by the author, discussing infection, transmission, and necessity of control.

Mosaic diseases of sugar cane. West Indies Agric. Conf. Proc. 1924, **9**: 76–82, 1925. (Rev. Appl. Mycol. **5**(2): 134, 135, 1926.)

This paper is devoted almost entirely to control and includes a a discussion of transmission by *Aphis Maidis*.

----------, **& Murray, P[ercival] W[aterhouse]**

The mosaic disease of sugar cane and its control in Jamaica. Journ. Dept. Agric. Microbiol. Circ. **6**, 39 p., 1926. (Int. Sugar Journ. **29**(341): 240–242, 1927. Rev. Appl. Ent. Ser. A. **15**: 96, 1927. Rev. Appl. Mycol. **6**: 185, 1927.)

This is in reality two papers. The first by the senior author giving general discussion of symptoms, cause, transmission, hosts, effects on the cane and methods of control. The second by the junior author stating his experience in field control of the disease.

Annual Report of the Mycologist. Uganda Dept. Agric. Ann. Rpt. **1920**: 48–49, 1931.

Mosaic is still the most important sugar cane disease. P. O. J. 213, 2725 and 2727 are planted as resistant or immune varieties. Streak disease of corn prevails but is not found in sugar cane.

Hanson, A[rthur] P[anton]

Mosaic disease. Journ Jamaica Agric. Soc. **28**: 242–243, 1924.

The author discusses symptoms, effects and methods of control.

Haring, C[larence] M[elvin]

The beet leafhopper *Eutettix tenella*, Baker California Agric. Expt. Sta. Ann. Rpt. **1920–21**: 41–42, 1922

Harreveld, Ph[ilippus] van

Strepenziekte in bibittuinen (Stripe diseases in nurseries.) Arch voor de Java Suiker Indus **18** 919–922, 1919

An unusual outbreak of the disease in nurseries was noticed this year Planting of healthy cuttings improved the conditions

Gelestrepenziekte en bladluizen (Yellow-stripe disease and leaf lice) Arch voor de Java Suiker Indus **30**(16) 261–262, (17) 362–364, 1922. (Korte Meded Proefstation Java Suiker Indus. No. **4**, 1922)

A popular discussion.

Harrington, F[rank] M.

Tuber indexing versus tuber uniting and roguing in seed potato production Amer Potato Journ **9**(8) 128–131, 1932.

A summary of field studies.

Harris, R. V.

Grafting as a method for investigating a possible virus disease of the strawberry Journ. Pom. & Hort. Sci **10**(1): 35–41, 1932.

Description of method.

The strawberry "yellow edge" disease. Journ. Pom. & Hort. Sci. **11**(1) 56–76 1933

Account of two years experimental work, the results of which showed that the disease is of the virus type transmissible by grafting, gives method of control.

---- ----, & **Grubb, N. H.**

The commercial control of raspberry-mosaic disease. East Malling Res. Stat. Ann. Rpt. **1932**: 149–151, 1933.

Description of work done on the establishment of mosaic-free nurseries of raspberries. Full directions are given for the planting and maintenance of such nurseries.

Hart, W. C., & Rengaswamy, S.

Preliminary investigations into the cause and cure of spike diseases of sandal (*Santalum album*) in the North Salem Division. Madras Presidency Indian Forester **52**(8): 373–390, 1926.

An outline of methods.

Harter, L[eonard] L[ee], & Whitney, W[ill] A[lvah]

Masking sweet potato mosaic. Phytopathology **19**(10): 933–942, 1929; (Rev. Appl. Mycol. **9**: 267, 1930.)

The author reports the masking on new growth at 38 degrees C.

Hartley, Carl Pierce

Pale dwarf disease of plant (*Arachis hypogaea*). Phytopathology **17**: 217-225, 1927.

A report on a disease found in Java. The author has found this disease in seedlings grown from seed from Africa.

------------, Haasis, Ferdinand W[ead]

Brooming disease of black locust (*Robina pseudoacacia*). Phytopathology **19**(2): 163–166, 1929

A description of a disease resembling peach yellows but the authors do not give any proof that it is caused by a virus.

A Brooming disease of Robina pseudoacacia transmitted by grafts. Phytopathology (Abstract) **23**(1): 13, 1933.

Harvey, R[oney] B[eecher]

Hydrogen-ion changes in the mosaic disease of tobacco plants and their relation to catalase. Journ. Biol. Che. **42**: 397–400, 1920.

Haskell, Royal J[oyslin], & Martin, George H[amilton]

Summary of plant disease in the United States in 1918. II Diseases of field and vegetable crops. U. S. D. A. Br. Plant Industry. Plant Disease Bull. Suppl. **2**: 42–83, 1919.

The Fiji disease of sugar cane. Trop. Agric. (Ceylon) **56**: 381–383, 1921.

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Diseases of cereals and forage crops in the United States in 1928. U. S. D. A. Plant Disease Reporter Suppl. **71**: 259–323, 1929. (Rev. Appl. Mycol **9**(2): 93, 1930.)

__________, & **Archer, William A[ndrew]**

Salsify yellows. U. S. D. A. Plant Disease Reporter **13**: 139–140. (Rev. Appl. Mycol. **9**: 224, 1930.)

United States of America: Plant Disease survey notes. International Bull. Plant Protect. **3**: 179–180, 1929. (Rev. Appl. Mycol. **9**: 288; 1930.)

Reports celery yellows caused by aster yellows virus and transmitted by *Cicadula sexnotata*.

_____________, & **Wood, Jessie I[da]**

Diseases of plants in the United States in 1929. U.S.D.A. Plant Diseases Reporter Suppl. **75**.

Handuroy, P.

Les ultravirus. Deuxième Congr. Intern. Path. Comp. (Paris) Rpts. **1**: 321–338, 1931.

Hause, H.

Transfer of variegation from scion to stock. Gard. Chron. **1893**: 849, 1893.

It refers to Horse chestnut.

Hawley, I[ra] M[yron]

Relation between curly top and beet leaf hopper. Utah Agric. Expt. Sta. Misc. Pub. No. **3**. 1927.

Hayes, T. R.

Groundnut rosette disease in the Gambia. Trop. Agric. (Trinidad) **9**(7): 211–217, 1932.

A review of our knowledge of the subject with the results of studies of weed carriers.

Heald, F[rederick] D[e Forest]

Division of Plant Pathology. Washington Agric. Expt. Sta. Bull. **245**: 47–50, 1930.

The works of L. K. Jones are reported in regard to the rate of spread of tomato streak. Brief notes on other virus diseases are given.

Forty-second Annual Report Washington Dept. Agric. for the fiscal year ending June 30, 1932. Washington Agric. Expt. Sta. Bull. **275**, 34 p., 1932.

Account of studies on little leaf or rosette of apple, peach and cherry, and latent veinbanding viruses of potato.

____________, & **Burnett, G.**

A virus disease of perennial delphiniums. Bull. Amer. Delphiniums Soc. **2**(2): 14–21, 1934.

Hédin, L[ouis]

Culture du manioc en côte d' Ivoire; observations complémentaires sur la mosaïque. (Culture of manioc in Ivory Coast supplementary observation on mosaic.) Rév. Bot. Appl. Agri. Trop. **11**: 558–563, 1931.

Hedlund, [Johan] T[eodor]

(Some observations on the leaf-roll disease of the potato) Tidskr. Landtman. **31**: 512–515, 532–541, 1910. (Abstract: in Bot. Centralbl. **114**(22): 567–568.) 1910.

Über die gewöhnchsten krankheiten der kartoffel. (About the common diseases of potato.) Tidskr. f. Landtman, 15 p., 1913.

Heim, Roger

Maladies á virus et maladies bactériennes des plantes coloniales: état actuel de la question. (Virus and bacterial disease of colonial plants; actual state of the question.) Cryptog. Exotique, (Paris) **4**(2): 104–110, 1931.

Hein, I[llo]

Changes in plastids in variegated plants. Bull. Torrey Bot. Club. **53**: 411–418, 1926.

The author makes a study of a number of plants and says:—"In all these cases it would seem that the spotting must be caused by a chlorophyl destroying agent which spreads radially and disorganizes the plastids as it penetrates from cell to cell."

Heintzel, K[urt Gustav] Emil

Contagiose Pflanzenkrakheiten ohne Microben unter besonderer Berucksichtingung der Mosaikkrankheit der Tabakablätter. (Contagious plant diseases not bacterial on peculiar contact transmission of the mosaic disease of tobacco leaves.) Inaug Diss. Univ. Erlangen, p. 1–45, 1900.

Hell, W. F. van

Onderzoekingen over Ziekten van Lilies. (Investigations on lily diseases.) Theasis Univ. of Utracht, 116 pp., 1931.

The author records yellow flat in Holland on L. *longiflorum* var, *giganteum* and *formosum* and mosaic on L. *longiflorum*, L. *aurantum* and L. *speciosum*.

Henderson, L[ouis] F[ourniquet]

Tomato blight. Idaho Agric. Expt. Sta. Ann. Rpt. **1904**: 1–55, 1905.

Henderson, R[obert] G[ordon]

Transmission of tobacco ring spot by seed of *Petunia*. Phytopathology **21**(2): 225–229, 1931.

The author discusses the subject briefly, giving results of experimental work.

————————, **& Wingard, S[amuel] A[ndrew]**

Further studies on tobacco ringspot in Virginia. Journ. Agric. Res. **43**(3): 191–207, 1931.

Natural infections on many plants have been reported. The symptoms differ from true ring spot in severity. It has been suggested that this is due to attenuation of the virus. Jimson weed and cataloupe are natural hosts. Thermal death point is between 60° and 70° C. The virus is readily inactivated by desiccation. The paper contains much other valuable data.

Increasing the resistance of tobacco ring spot virus to ageing *in vitro* by use of carbolic acid Phytopathology (Abstract) **23**(1): 14–15, 1933.

Effect of air temperature on tobacco ring-spot infection. Phytopathology (Abstract) **24**(1): 10–11, 1934.

Occurrence of tobacco ring-spot-like viruses in sweet clover. Phytopathology **24**(3): 248–256, 1934.

Discussion of the natural occurrence of ring-spot-like viruses on sweet clover. The authors reports a new virosis of sweet clover, describing its symptoms. The virus is infectious on tobacco, producing symptoms of the necrotic-pattern type but distinctly different from the symptoms of ring spot.

Henderson, W. J.

Indexing as a control measure for the yellow dwarf disease of onion. Phytopath. (Abstract) 20(1): 115, 1930.

Varietal susceptibility, distribution and control of yellow dwarf onion. Phytopathology (Abstract) **21**(1): 123, 1931.

Studies of the properties and host reactions of the onion to the yellow dwarf virus. Phytopathology (Abstract) **22**(1): 11, 1932.

Henning, E[rnst Johan]

Kort oversikt over viktigare smittosamme sjukdomar hos potatisen Stockholm: Wilhelmssons Boktr 28 p., 1915.

Herbert, D. A.

Bitter pit of apples The crushed cell theory. Phytopathology **12**(10) 489–491, 1922

Discussion of the theory Written before the cause was known

Heribert-Nilsson, N[ils]

Sortsheststens och lokalinfectionsfrihet med avseende pa bladrullsjukan hos potatis (Varietal resistance and local freedom from infection in connection with potato leaf-roll.) Weibull Arsbok **21** 30–33, 1927

Hernández, Adrián

Yellow stripe disease of cane in the Philippines Sugar Central & Planters' News **1** 36, 1920

Mosaic diseases Philippine Islands Br Agric. Ann. Rpt. **1923**: 167–168, 1924.

Hernández Torres, C.

Control del "mosaico" o "rayas amarillas" de la caña de azúcar (Control of "mosaic" or "Yellow stripe" disease of sugar cane) Rev Agric Com & Trab Cuba **10**(4) 16, 1928.

Hertzsch, Walther

Beitrage zur Infektiosen Chlorose (Contribution on infectious chlorosis) Zeitschr fur Bot **20**(2 3) 65–85, 1927

Two infectious diseases of *Abutilon* which have been confused by earlier writers

Infektiose chlorosen. (Infectious chlorosis.) Der Zuchter **2** (7) 196–199 1930

The author reports two forms of infectious chlorosis A & B in *Abutilon* and other Malvaceae.

Heuberger, J. W., & Moyer, A[ndrew] J.

Influence of mosaic infection on tomato yields Phytopathology **21**(7) · 745–749, 1931.

Tabulated results of experiments are given. Late infections cause less losses than early infections.

————, & Norton, J. B. S.

Water loss in tomato mosaic. Phytopathology (Abstract) **23** (1): 15, 1933.

————————, & ————————
The mosaic disease of tomatoes. Maryland Agric. Expt. Sta. Bull. **345**: 447–486, 1933.
Popular.

Hiltner, L[orenz]
Einige Bemerkungen über die Blattrollkrankheit der Kartoffeln. (Some observations on the leafroll disease of potatoes.) Prakt. Bl. Pflanzenb. u. Pflanzensch. **4**: 25–30, 1908.

Ueber den Zusammenhang der Blattrollkrankheit der Kartoffel in Bayern. (The actual state of ring and leaf roll disease of potatoes in Bayern.) Prakt. Bl. Pflanzenb, u Pflanzensch. **6**: 86–87, 1908.

————————, & **Gentner, G[eorge]**
Ueber den Zusammenhang der Blattrollkrankheit der Kartoffel mit der Stärkeanhäufung in ihren Blättern. (On the relation of leafroll disease of potato with the starch accumulation in its leaves.) Prakt Bl. Pflanzenb. u. Pflanzensch. **16**: 138–141, 1918.

Versuche uber die Uraschen der Blattrollkrankheit der Kartoffel. II Weitere Beobachtungen uber die "Stärkeschoppung" in Blattrolkranken Kartoffelstanden. Praktische Blätter fur Pflanzenbau und Pflanzenzencht. (Munchen) **17**: 15–19, 39–49, 1919.

Himmelbaur, Wolfgang.
Die Blattrolkrankheit der Kartoffel. (The leaf-roll disease of the potato.) Wiener. Landw. Zeitg. **74**: 43–44, 1924.

Hind, R[obert] R[enton]
Toledo cane, a mosaic-immune variety. Sugar Central & Planters' News **4**(3): 105–107, 1923. (Rev. Appl. Mycol. **2**: 468, 1923.)

Hinson W[alter] M., & Jankins, E[dward] H[opkins]
The management of tobacco seed beds. Connecticut Agric. Expt. Station. (New Haven) Bull. **166**, 1910.
A brief reference to calico (mosaic) in the seed beds.

Hockey, J[ohn] Fred[erick]

Report of the Dominion Laboratory of Plant Pathology. Canada Dept. Agric St. Catherine, Ontario Div. Bot. Rpt. **1922-23** 32–43, 1923.

Mosaic and leaf curl of the cultivated raspberry. Canada Expt Farms Circ. **1**, 4 p, 1923.

The control of raspberry mosaic Phytopathology (Abstract) **13**(6) 292, 1923.

The control of spread of mosaic of potatoes by the use of nicotine dust Rpt Dom Bot **1927** 205, 1928.

Hodgson, C. M.

Spiked sandal wood Indian Forester **44** 66–71, 1918.

Spike disease of sandal Indian Forester **44** 325–334, 1918.

"I write to record my opinion that spike is not caused by fire, *Zyzyphus*, *Lantana* (*L. Camara*) or any other of the environment but an internal ailment due to some germ or to some pathological condition."

Hodson, W[illiam] E[dgar] H[umphreys]

Narcissus pests Min Agric. & Fisheries Bull. **51**, 1932

Hoffman, M.

Plant diseases Jahresber. Land **24** 203–210 1909

Hoggan, Ismé A[ldyth]

Cytological studies on virus diseases of solanaceous plants. Journ Agric Res **35**(7). 651–672, 1927

This paper gives a brief review of the literature and the results of a very thorough study on the virus diseases of a number of solanaceous plants Special attention is given to the X-bodies and other materials "It is believed that the evidence presented in this paper is on the whole in favor of the view that the X-bodies are not of the nature of a causal organism."

———, **& Johnson, James**

"Not Guilty" is the verdict against peach aphids. Wisconsin Agric Expt. Sta Bull. **405**: 115–116, 1929.

Based on field observations and experimental tests the authors found out that *Mysus persicae* is not a vector of tobacco mosaic disease.

The peach aphids (*Myzus persicae* Sulz) as an agent in virus transmission Phytopathology **19**(2) 109–123, 1929

Myzus persicae transmitted cucumber virus to tobacco and other solanaceous plants and from tobacco to tobacco, but it did not transmit tobacco mosaic from tobacco to tobacco

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Transmission of cucumber mosaic to spinach Phytopathology **20**(1) 103–105, 1930

Virus from mosaic cucumbers was transmitted to spinach by *Myzus persicae* and *Macrosiphum solanifolii* The symptoms resembles those of spinach blight

Aphid transmission of plant viruses Phytopathology (Abstract) **20**(1) 133 1930

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Studies on aphid transmission of plant viruses Journ Bact **19**(1) 21–22 1930 (Rev Appl Mycol **9** 413, 1930)

Greenhouse experiments demonstrated that (1) *Myzus pseudosolani* and *Macrosiphum solanifolii* can transmit tobacco mosaic virus from tomato to other solanaceous hosts, but cannot transmit it to tobacco (2) Can transmit cucumber mosaic virus from tobacco and tomato (3) *Myzus circumflexus* can transmit cucumber mosaic from tobacco and tomato but cannot transmit tobacco mosaic from tobacco

Further studies on aphid transmission of plant viruses Phytopathology **21**(2) 199 212 1931

Studies on aphid vectors were conducted on different species of aphids to determine their ability to transmit the viruses of ordinary tomato mosaic Evidence showed that aphids are unlikely to be responsible for any dissemination of ordinary tobacco mosaic, so far as tobacco is concerned

Some factors involved in aphid transmission of the cucumber-mosaic virus to tobacco Journ Agric Res **47**(9) 689–704, 1933

Report of the results of experiments obtained given in detail The aphid under study was *Myzus persicae*

Some virus affecting spinach, and certain aspects of insect transmission Phytopathology **23**(5) 446–474, 1933

Results of observations and experiments made by the author in re-

gard to the transmissibility of different viruses on Spinach (*Spinacia oleracea*) e. g. cucumber mosaic, sugar beet mosaic and tobacco ring spot mosaic virus diseases.

Holden, J. A.

Spindel-tuber disease. U.S.D.A. Circ. **5**: 27–28, 1927.

Report of an experiment to determine whether the spindle-tuber disease of potatoes is carried by irrigation water. The experiment gave negative results.

Hole, R[obert] S[elby]

Spike disease of sandal. Indian Forester **44**: 325–334, 1918.

A review of a paper by Venkataraman Ayyar (Indian Forester **44**: 316–324) defending statements in a previous paper (Indian Forester **44**: 430.) The disease was probably present before 1898. Believes that trenching experiments should be continued. Injury by fire may be a factor under dry conditions.

Spike disease of sandal. Indian Forester **44**: 461–462, 1918.

Criticism of paper by Lushington and a defense of his own opinion.

Cause of the spike diseases of sandal. (*Santalum album.*) Indian For. **43**: 429–442, 1917. (Bot. Abs. **2**: 215, 1919.)

Cause of the spike disease of sandal. Indian Forest **45**: 133–139, 1919.

Further information of the disease given in previous articles.

Holland, T. H.

Plantains and bunchy top. Trop. Agric. (Ceylon) **66**(2): 125, 1926.

Report of measures of control of the disease, which were unsuccessful.

Hollins, E.

Discussing curl or degeneration of potatoes. Trans. Soc. Encouragement of Arts. Manuf. and Commerce **8**, 1790. Read the 20th October, 1789.

Historical value.

Hallowell, E. A., Monteith Jr., John., & Flint, W. P.

Leaf hopper injury to clover. Phytopathology (Abstract) **17** (1): 58, 1927.

Not due to a virus, but the symptoms are similar.

Hollrung, Max

(Annual Report on Plant Diseases.) Jahresber. Pflanzenkrank. **12**(8): 356, 1909.

Holmes, Francis O[liver]

Monochromatic light photography in the study of mosaic disease Phytopathology (Abstract) **18**(1): 154, 1928.

Accuracy in quantitative work with tobacco mosaic virus. Bot. Gaz. **86**(1): 66–81, 1928.

A description, a method and the result of the experimental work.

Accuracy in comparing various concentrations of tobacco mosaic virus. Phytopathology (Abstract) **18**(1): 132, 1928.

Describes method of inoculation with needles and experimental results.

Cytological study of the intracellular body characteristic of *Hippeastrum* mosaic Bot. Gaz. **86**(1): 50–58, 1928.

The author reports that no nucleus was found in the bodies but chondriosome were found. "Whether the body represents a stage in a foreign organism, a mass of plant cell cytoplasm containing virus, or a mass of the plant cell cytoplasm not immediately in contact with virus but stimulated by the diseased cond tions is not known."

Ultra-violet light photography in the study of plant virus. Bot. Gaz. **86**(1): 59–65, 1928.

Gives results of photographic experiments for purpose of finding special structure in mosaic plants. The results were negative.

Local lesions in tobacco mosaic. Bot. Gaz. **87**(1): 39–55, 1929. (Contri. Boyce Thompson Inst. **1**: 504–520, 1929.)

Gives the results of the inoculation of a number of species of *Nicotiana* with common tobacco mosaic. Five species developed lesions. Gives a "standardized method for using *N. glutinosa* as a test plant for measuring the concentration of mosaic virus.

Inoculating methods in tobacco mosaic studies. Bot. Gaz. **87** (1): 56–63, 1929. (Contr. Boyce Thompson Inst. **1**: 521–528, 1929.)

This paper gives the results of several methods of mechanical inoculation and recommends the application of the virus to the surface before making the wounds.

Local symptoms of mosaic in the leaves of some *Nicotiana* species. Phytopathology (Abstract) **19**(1): 92–93, 1929.

Local and systemic increase of tobacco mosaic virus. Amer. Journ. Bot. **17**(8): 789–805, 1930. (Boyce Thompson Inst. Contrib. **2**(10): 563–579, 1930.)

By means of measurements the author studies the concentration of virus in relation to local lesions and its spread in the plant.

Local lesions of mosaic in *Nicotiana tabacum* L. Boyce Thompson Inst. Contrib. **3**(2): 163–171, 1931.

Local lesions of mosaic in *Nicotiana tabacum* L. are described and discussed.

Local lesions of mosaic in *Nicotiana tabacum*. Phytopathology (Abstract) **21**(1): 119, 1931.

Movement of mosaic virus from primary lesions in *Nicotiana tabacum* L. Boyce Thompson Inst. Contr. **4**(3): 297–322, 1932.

A thorough description of the author's observations of the movement of the mosaic virus in primary lesion in *Nicotiana tabacum* L. with description of symptoms produced by artificial inoculations.

Symptoms of tobacco mosaic disease. Contr. Boyce Thompson Inst. **4**(3): 323–357, 1932.

The author describes primary and secondary symptoms resulting from inoculating tobacco mosaic virus into *Nicotiana, Solanum, Capsicum, Lycopersicum, Datura, Petunia, Nicandra, Lycium, Hyoscyamus, Martynia* and *Phaseolus*. The descriptions include a number of symptoms not recorded by previous workers.

Masked strain of tobacco-mosaic virus. Phytopathology (Abstract) **24**(1): 11–12, 1934.

Holmes Smith, (A) E.

Spotted wilt disease of tomatoes. Gard. Chron. **94**(2445): 350, 1933.

Account of the occurrence of an outbreak of spotted wilt disease of tomatoes in Manchester (England). Description of the effect of the disease on the plant and on the crop. The author suggests the applications of calcium cyanide or the dusting of the foliage with naphthalene to control *Thrips tabaci* the vector of the disease.

Hoog, J.

The breaking of tulips. Gard. Chron. **94**(2452): 471, 1933.

Brief historical note of this disorder in tulips.

Hopkins, J[ohn] C[ollier] F[rederick]

Mosaic disease of tobacco Rhodesia Agric Journ. **25**: 188–194 1928

A popular paper

Leaf spotting of tobacco caused by mosaic Rhodesia Agric. Journ **26**(9) 912–916 1929 (Rev Appl Mycol **9**(2): 138, 1930)

A description of this type of mosaic on tobacco

Plant Patholog in Southern Rhodesia during the year 1930 Rhodesia Agric Journ **28**(4) 384–389, 1931

Masked tobacco mosaic is reported Also ring spot virus disease of tobacco as a new record

Leaf curl of tobacco in Southern Rhodesia Rhodesia Agric. Journ **29**(9) 680–686 1932

This paper gives the results of experimental studies The disease is carried by white flies (Aleurodidae)

Hori, S.

(Material for the study of dwarf diseases) Journ Plant Protect 7 667–671 1920 8 117–120, 1921

(Chlorosis or mosaic disease of cucurbits) Agric World 17 (16) 22–30, 1922

Horne, A[rthur] S[amuel]

The symptoms of internal disease and sprain Journ Agric Sci 3 323 1910

On the potato leaf blotch and leaf curl Journ Roy Hort Soc (London) **36**(3) 618 623 1911

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Blotch and streak in potatoes Journ Roy Hort Soc (London) **39**(3) 607–614 1914

Horne, W[illia]m T[itus,] & Parker E[dwin] R.

The avocado disease sun blotch Phytopathology (Abstract) **20**(10) 852, 1930

Record of a disease of avocado in California with characteristics of an infectious chlorosis

The avocado disease called sun blotch. Phytopathology **21**: 235–238, 1931.

The disease is thought to be an infectious chlorosis.

The avocado sun-blotch disease. California State Dept. Agric. Mo. Bull. **20**(7): 447–454, 1931.

Popular article describing the disease. Practical methods of control are suggested.

Avocado diseases in California. Phytopathology **22**(1): 12–13, 1932.

Abstract in which the author states that "*Chlorosis* and *little leaf* apparently parallel similar diseases of citrus. *Sun blotch*, is an infectious disease."

Horsfall, J[ohn] L[ouis]

The effects of feeding punctures of Aphids on certain plant tissues. Penn. Agric. Expt. Sta. Bull. **182**, 1923.

Gives the results of histological studies by which the author was able to follow the course of the probosis in the tissue of the plant.

Howard, Albert

Spike disease of peach trees, an example of unbalanced sap circulation. Indian For. **45**: 611–617, 1919.

The author believes that sandal spike is similar to peach spike and that it is due to the imperfect union of the root haustoria with the host.

Agriculture and Science. Agric. Journ. of India. **21**(3): 171–182, 1926. (Sugar News **7**(6): 381–386; (7): 471–477; (8): 537–543, 1926.)

Howdeniensis

On the curl in potatoes. Young's Ann. Agric. **43**: 595–596, 1805.

Howitt, John E[aton]

Raspberry yellows and cane blight. Canad. Hort. **36**(10): 237–238, 1913.

————————, **& Stone, R[oland] E[lisha]**

A troublesome disease of winter tomatoes. Phytopathology **6**(2): 162–166, 1916.

This is evidently a virus disease but was not recognized as such at the time of the publication of this paper.

Botany Ontario Agric Col & Expt Farms, Ann. Rpt. 1918. **44** 19–21, 72–78, 1919
Brief references to mosaic diseases Results of field studies.

Some observations made in inspecting for leaf-roll and mosaic. Phytopathology (Abstract) **10**(5) 316, 1920

Hunger, Friedrich W[ilhelm] T[obias]
Die Mosaick ziekte by Deli Tabak (The mosaic disease on Deli Tobacco) Deel 1 Meded uuit S' Lands Plantentuin **63**, 104 p, 1902

Een voorloopige verklaring optreden het veelvuding optreden der Mosaickziekte bij Sumatratabak (A preliminary statement showing the multeity manifested in mosaic disease of Sumatra tobacco) Tijds Nijverheid & Landvouw in Ned-Indie **67** 225-237 1903

Bemerkung zur Woods' schem Theorie uber die Mosaikkrankheit des Tabaks (Remarks on Woods' theory upon the mosaic disease of tobacco) Bull Inst Bot. Buitenzorg **17** 1–9, 1903.

Het Rupsen Toeken by tabak in verband met het later optreden der mosaiek ziekte Teysmannia **16** 632–638, 1903

(On the spreading of mosaic disease (Calico) on a tobacco field.) Inst. Bot Buitenzorg Bull **17** 10–16, 1903

Over de verspeding der mosaickziekte op een tabaksveld. (On the spreading of mosaic disease on a tobacco field) Handl. v h 7 Vlamsch Natuur en Geneeskunding Congress p. 1–14, 1903

Die verbreitung der Mosaikkrankheit infolge der Behandlug des Tabaks Centralbl. f Bakt. **11**: 405–408, 1904.

Over den aard der Cesmettelykheid der Mozaickziekte der Tabaksplant. Handl. v h. 8 Vlaamsche Natuur en Geneeskundink Congress **3**· 45–50, 1904

Infloed van het verspenen van tabaks bibit Korte Berichten Int's Lands Plantentuin Teymannia **15** 58–64, 1904

Neue Theorie zur Atiologie die Mosaikkrankeit des Tabaks Ber D Bot Ges **23**(8) 415–418, 1905

A brief, preliminary paper giving the author's theory of "physiological catalytic" action Believes the mosaic of tobacco is due to a toxin which develops in the cells of the plant

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Untersuchugen und Betrachtungen uber die Mosaikkrankheit der Tabakspflanze Ztschr Pflanzenkrank **15**(5) 257–311, 1905

A more extensive paper than the proceeding which reviews the subject to date and reaffirming his opinion that the disease is due to an unorganized ferment which is different from an enzyme

Onderzoekingen en Geschouwingen over de mosaikziekte der tabaksplant (Investigations and considerations on the mosaic disease of the tobacco plant) Amsterdam 1906

Beschaduwing als prophylaxis tegen de Mosaikziekte der Tabak Mededeel Dept Landbouw **3** 62 68 1907

Die Verbreitung der Mosaikkrankheit infolge der Behandlung des Tabaks Centralbl f Bakt **2**(11) 405–408, 1908

Hungerford, Cha[rle]s W[illiam]

Leaf roll mosaic and certain other related diseases in Idaho Phytopathology **12**(3) 133–139 1922

This is a discussion of several virus diseases in Idaho, giving their history

Preliminary results of experiments with leaf roll and mosaic in Idaho Phytopathology (Abstract) **13**(11) 511–512, 1923

Western yellow tomato blight Idaho Agric Expt Sta Bull **131**, 71 p, 1923

---------, **& Balder, John Milford**

Mosaic and leaf-roll of potatoes in Idaho Phytopathology (Abstract) **14**(2) 123, 1924

----------, & **Dana, B[liss] F.**

Witches' broom of potatoes in the Northwest. Phytopathology **14**(8): 372–383, 1924.

A very complete discussion of the symptoms and nature of the disease based on observations and studies.

A new virus disease of *Delphinium* in Idaho. U.S.D.A. Plant Disease Reporter **17**(1): 5, 1933.

Huntley, F[red] A.

Tomato culture. Idaho Agric. Expt. Sta. Bull. **34**: 108–117, 1902.

Husain, M. Afzal

Leaf curl in cotton. Nature **126**(3190): 958, 1930.

Short note about the occurrence of this disease in Punjab, India.

Leaf-curl in cotton and other plants. Nature, **130**(3278): 312, 1932.

The disease is common in potato, tomato and pepper (*C. annuum.*)

Hutchins, L[ee] M[ilo]

Peach orchards in Georgia menanced by phony disease. U. S. D. A. Yearbook, **1927**: 499–503, 1928.

A brief statement concerning the spread of the disease and its effects on the fruit.

The cause and contagious nature of the phony disease of the peach. Proc. Ann. Meet. Georgia State Hort. Soc. **53**: 25–32, 1929.

Popular discussion.

Phony disease of the peach. Phytopathology (Abstract) **19**(1): 107, 1929.

The phony disease of the peach. Mississippi State Plant Board Quart. Bull. **10**(1): 1–11, 1930.

A review of the history of the disease and its geographical distribution in Southern United States.

The phony disease of the peach. Journ. Econ. Ent. **23**(3): 555–562, 1930. (Rev. Path. Vég. **17**(8–9): 384, 1930.)

Peach mosaic, a new virus disease Science n.s. **76** (1962): 123, 1932 (Phytopathology (Abstract) **23**(1): 17, 1933.)

The first record of this new disease.

Identification and control of the phony disease of the peach Georgia Office of the State Entom Bull **78,** 55 p., 1933.

Extensive considerations about the disease in the State of Georgia. Description of the disease and damages caused, methods for identifications of the malady The author states also that circunstantial evidence points to the peach borer *Aegeria exitiosa* as the insect vector of the virus As the only method of control he recommends the destruction of infested trees.

Hutson, J. C., & Malcom, Park

Investigation of the bunchy top disease of plantains in Ceylon. Trop Agr (Ceylon) **75**(3) 129–140, 1930.

A review and description of this disease and experiments demonstrating that it is carried by *Pentalonia nigronervosa.* Root disease is not necessarily associated with bunchy top Eradication is the most satisfactory method of control.

Iachevskii, A.

Kratkii obzor sovremennogo sostoianua uchenua o vyrozhdenii i rastenii (A brief review of the present status of the study of degeneration in plants) Materialy po mikologii i Fitopatologii **7**(1) 195–207, 1928.

Ichitkawa, Nobujiro

On the similarity of mulberry dwarfs and peach yellows in regard to their symptoms and cause. Bot Mag Tokyo, **9**: 82–89, 1896

Ikeno, J.

Studies uber einen eigentumlichen Fall der infektiosen Buntblättrigheit bei *Capsicum annuum* Ztschr Wis Biol. E Planta **11**(2) 359–367, 1930.

Illingworth, J[ames] F[ranklin]

Yellow spot of pineapple in Hawaii Phytopathology **21**(9): 865–880, 1931

A new disease which is very important It is carried by thrips.

Preliminary report on evidence that mealy bugs are an important factor in pineapple wilt. Journ. Econ. Ent. **24**(4): 877–889, 1931.

Summary of four years' work on the subject in Hawaii. The author presents evidence that pineapple wilt is transmitted by *Pseudococcus brevipes*, Ckll. a mealy bug which infects the pineapple in Hawaii. He recommends biological control.

Ito, S.

(Diseases of potatoes with special reference to the virus diseases.) Govern. Hokkaido Bur. Indust. Agric. Bull. **32**, 24 p., 1930.

Iwanowski, D[mitri Josiphowitachz Valerian Viktorowitch]

Rjabucha bolesen tabaka, eja pritschini i sielstwo borbi snejen (Die Pokenkrankheit der Tabaspflanze.) (The spot disease of tobacco plant.) Mem. Acad. Imp. Sci. St. Petersburg **7** (37): 23, 1890.

Ueber zurie krankheiten der tabakspflanze. (About two tobacco diseases.) Bull. de l'Acad. Inspér d. Sci. St. Petersburg **2** (3): 67-70, 1892. (Abstracted in Beihefte Botanisches Centb. Jahrg. **3**: 266–268, 1893.)

Ueber die mosaikkrankheit der tabakspflanze. (About the mosaic disease of tobacco plant.) Centrabl. f. Bakt. **5**(8): 250–254, 1899.

Ueber die mosaikkrankheit der tabakspflanze. (About mosaic disease of tobacco plant.) Centrabl. f. Bakt. **7**: 148, 1901.

Die mosaik und pockenkrankheit der tabakspflanze. (Mosaic and the spot disease of tobacco plant.) Ztschr. f. Pfanzenkh. **12**(4): 202–203, 1902.

Discusses differences between mosaikkrankheit and pockenkrankheit.

Ueber die mosaikkrankheit der tabakspflanze. (About the mosaic disease of the tobacco plant.) Ztschr. Pflanzendrank. **13**(1): 1–14, 1903. (Bot. Centbl. 40, 1903.)

An extensive study of the disease with references to the work of previous workers. He believed the disease to be due to bacteria but failed to isolate an organism. He gives the results of inoculation experiments, filtering and observations.

Iyengar, A. V. V.

Contributions to the study of spike disease of sandal (*Santalum album* Linn.) II & III. Journ. Indian Inst. Sci. **11A**(9): 97–109, 1928.

Contributions to the study of spike disease of sandal. (*Santalum album*, Linn.) Part X. Seasonal Studies on healthy and partially spiked trees. Journ. Indian. Inst. Sci. **12A**(20): 295–305, 1929.

This paper gives the results of chemical analyses of the leaves made during the period of the development of the disease. Also of healthy leaves during the same period.

Iyengar, B. Narasimha

Spike disease of sandal. Mysore Dept. Agric. Ann. Rpt. **1922–23**: 10–12, 1923.

A brief record of studies on sandal wood.

Jackson, A[lbert] B[ruce]

A possible cause of spike in sandal. Indian Forester **45**: 635, 1919.

Suggests that the disease may be caused by excessive parasitism of sandal on sandal.

Jackson H[erbert] S[pencer] & Osner, G[eorgie] A[din]

Potato diseases in Indiana. Indiana Agric. Expt. Sta. (Perdue Univ.) Circ. **71**, 16 p., 1917.

Jackson, L. W. R., & Hartley, Carl

Transmissibility of the brooming disease of Black Locust. Phytopathology **23**(1): 83–90, 1933.

Detailed report of the authors in the transmissibility of brooming disease of *Robina pseudacacia*. The disease is considered to be caused by a virus. Attempts to transmit it by budding gave negative results, although it was successfully transmitted by grafting.

Jaczwski, A[rthur] L[ouis]

(Degeneration diseases of the potato according to the results of the investigations made in 1924.) Central Potato Cooperation Union, Moscow, 65 p., 1925.

(Witches' broom of potato.) Materials for Mycology & Phytopathology **5**(2): 117–128, 1926.

Mesures practiques contre les maladies de la dégénérescence. (Practical measures against the degeneration diseases.) Défense des plantes, **4**(1): 62–77, 1927.

(A summary of the present status of the study of degeneration diseases in plants.) Mat. Mycol. & Phytopath., Leningrad, **7**: 195–207, 1928.

(Ring spot of tobacco leaves.) Ann. Inst. Expt. Agron. (Leningrad) **6**: 61–65, 1928. (Rev. Appl. Mycol. **9**: 347, 1930.)

A report of a ring spot which the author believes to be the same as the ring spot in the United States.

Jagger, I[van] C[laude]

Experiments with the cucumber mosaic disease. Phytopathology **6**(2): 148–151, 1916.

Gives the results of inoculation experiments and demonstrates that the disease is carried by *Aphis gossypii* Glover.

Two transmissible mosaic diseases of cucumber. Phytopathology (Abstract) **7**(1): 61, 1917.

Host of the white pickle mosaic disease of cucumber. Phytopathology **8**(1): 32–33, 1918.

A brief note giving the hosts for this virus.

Mosaic disease of cucurbits. Phytopathology (Abstract) **8**(2): 74–75, 1918.

Transmissible mosaic disease of lettuce. Journ. Agric. Res. **20** (10): 737–740, 1921.

Symptoms and transmission experiments.

Jaguenaud, G.

Recherches sur la dégénérescence de la pomme de terre. (Researches on the degeneration of the potato) Compt. Rend. Acad. Agr. France. **17**(10): 318–322, 1931.

(Th influence of the soil and its position on the degeneration of th potato.) Compt. Rend. Acad. Sci. **193**: 582, 1931.

Janse, J. M.

Proeve eener verklaring van sereh verschijn selen. Meded uit's Lands Plantentuin te Buitenzorg, **8**: 1–39, 1891.

Janssen, J. J.

Invloed der bemesting op de gezondheid van de aardappel. (Influence of manuring on the health of the potato.) Tijdschr. Plantenziek. **35**(5): 119–151, 1929.

This paper is devoted primary to the relation of soils and fertilizers to the virus diseases.

Jarrett, Phyllis H.

Streak. —a virus disease of tomatoes. Ann. Appl. Biol. **17**(2): 248–259, 1930.

A comparison of this disease with a disease produced by inoculation with a mixture of juice from mosaic potato and mosaic tobacco plants. The author concludes that the glass house streak of tomato does not contain potato virus. Tobacco mosaic and tomato streak appear to be due to a single virus.

The role of *Thrips tabaci* Lindeman in the transmission of virus diseases of tomato. Ann. Appl. Biol. **17**(3): 444–451, 1930.

After experimentation to show the role of *Thrips tabaci* Lindeman in the transmission of virus disease of tomato, it is concluded that it does not transmit the disease under all conditions.

Jehle, R[obert] A[ndrew]

Disasterous effects of mosaic on the McCormick potato. Maryland Agric. Expt. Sta. Bull. **282**: 215–219, 1926.

A popular paper giving valuable data.

Jensen, H[jalmer]

Ueber die Bekampfung der Mosaikkrankheit der Tabakpflanze (About the control of mosaic disease of the tobacco plant.) Contrabl. f. Bakt. **15**: 440–445, 1906.

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(Pathology and physiology of tabacco in the Crown Lands.) Proefstat. Vorsteland, Tabak (Dutch East Indies). Meded. **5**: 7–78, 122–130, 137, 197–198, 1913.

A record of the work of Raciborski and Jensen for the years 1898–1911.

Eenige onderzoekingen over mozaikziekte bij de tabac. (Some investigations on mosaic disease of tobacco.) Meded. Proefstat. Vorsteland. Tabak **33**: 59–66, 1918.

The author reports that diseased plants may produce new foliage which does not show symptoms but this is not a proof that the plants have recovered.

Jensen, James H.

Leaf enation resulting from tobacco mosaic infection in certain species of *Nicotiana L.* Contr. Boyce Thompson Inst. **5**(1): 129–142, 1933.

This paper is the result of a study of outgrowths on the lower side of leaves of mosaic *Nicotiana paniculata* and *N. tomentosa*. They did

not occur in plants shaded from direct sun light. Similar outgrowth occur occasionally on *N. tabacum* var. *angustifolia* grown from cutting but not on plants grown from the seeds. These outgrowths sometimes produce palisade cells on the lower surface.

Isolation of yellow-mosaic viruses from plants infected with tobacco mosaic. Phytopathology **23**(12): 964–974, 1933.

The author gives his observations in experimental work and concludes that viruses of yellow mosaic arise during multiplication of tobacco mosaic virus in infected plants.

Jiménez Núñez, E.

Cultivo de la caña de azúcar (Sugar cane cultivation.) Centro Nal de Agric (Argentina) Bull. **6** 3–24, 1930

Jivanna Rao, P. S.

The cause of spike in sandal (*Santalum album*) Indian For. **46** 469–487, 1920 (Bot Abs **7** 173, 1921.)

The physiological anatomy of the spiked leaf in sandal (*Santalum album* L.) Indian For. **49**(9) 351–360, 1921 (Bot. Abs **10**·285, 1922.)

The cause of spike disease in sandal (*Santalum album* L.) Indian Sci. Congr Proc **11** 149, 1924.

The virus theory in relation to spike disease of sandal. Imp. Bot Confr (London.) p. 357–359, 1924.

Jochems, S[arah] C[amelia] J[ohannes]

Ziekten van Deli—tabak (Diseases of deli-tobacco) Meded. Deli Proefstat Medan Sumatra 2 ser **43**, 39 p., 1926.

A popular discussion of many diseases, including virus diseases. Exceptionally well illustrated.

Eene niewe virusziekte van Deli-tabak, de Rotterdam B-ziekte. (A new virus disease in Deli-tobacco, the Rotterdam B-disease.) Meded. Deli Proefstat. Medam Sumatra Bull. **26**, 26 p., 1928.

A record of a new virus disease of tobacco under the name of "Rotterdam B-Disease".

Twee nieuwe virusziekten bij Deli-Tabak (Ringvlekziekte en nerfstreep.) (Two new virus diseases of Deli Tobacco (ring-

spot disease and vein streak.) Deli Proefstat. te Medam Sumatra Bull. **30,** 24 p., 1930.

Description of these two diseases and record of inoculation experiments.

Jodidi, S[amuel] L[eo], Kellog, E[dward] H., & True, Rodney H[oward]

Nitrogen metabolism in normal and blighted spinach. Journ. Agric. Res. **15**: 385–408, 1918.

The diseased plants have a low nitrogen content and a high ammonia content. The authors record a number of differences in chemical content between diseased and healthy plants.

------------, **Moulton, S[tarley] C[heney,] & Mackley, K. S.**

Mosaic disease of spinach as characterized by its nitrogen constituents. Journ. Amer. Chem. Soc. **42**: 1061–1070, 1920.

A mosaic disease of cabbage as revealed by its nitrogen constituents. Journ. Amer. Chem. Soc. **42**: 1883–1893, 1920. (Science n. s. **52**(1355): 588, 1920.)

Joest, Ernest

Ueberkannte Ifektionsstoffe. Centralbl. f. Bak. **31**: 365, 1902.

Joglar Rodríguez, F[rancisco]

"El mosaico" enfermedad del tabaco. ("The mosaic" disease of tobacco.) Rev. Agric. Puerto Rico, **25**(10): 150, 176, 1930.

Popular discussion and description.

Johnson, A[aron] G[uy,] Mc Kinney, H[arold] H[all,] Webb, Robert W[illiam,] Leighty, Clyde E[vert]

The rosette disease and its control. U.S.D.A. Farmers' Bull. **1414,** 10 p., 1924.

Popular.

Johnson B[urt] Parker, & Duggar B[enjamin] M[inge]

Stomatal infection with the virus of tabacco mosaic. Phytopathology (Abstract) **20**(1): 141–142, 1930.

Concentration of the virus of the mosaic of tobacco. Amer Journ. Bot. **21**(1): 42-53, 1934.

The author precipitated material containing virus with a direct 110 volt current and with several salts. Some carbons can be used to clarify the juice and leave the tobacco in suspension. The author describes a method for preparing highly concentrated suspensions. There is a difference in the protein reaction of juices from healthy and mosaic plants. The positive protein reaction may be due to products associated with the virus.

Johnson, E[dward] M[arshall]

Virus diseases of tobacco in Kentucky. Kentucky Agric. Expt. Sta. Bull **306**: 289–415, 1930

A ringspot like virus disease of red clover. Phytopathology **23**(9) 746–747, 1933.

Report and description of a clover disease which shows virus like symptoms.

Johnson G[eorge] W[illiam]

The tomato its culture uses and history Gard Monthly, Vol. I, 1847

Johnson, James

Diseases of tobacco Wisconsin Agric Expt Sta Bull **327**, 27 p 1914

The relation of air temperature to certain plant diseases Phytopathology **11**(11) 446–458, 1921

Experimental evidence relating to the nature of the mosaic virus Phytopathology (Abstract) **12**(1) 52, 1922

The relation of air temperature to the mosaic disease of potatoes and other plants Phytopathology **12**(9): 438–440, 1922.

The optimum temperature lies between 14 and 18° C The symptoms disappear with temperature above 20° C

---------, & Mulvania M[aurice]

A new method of obtaining mosaic "virus". Science n s. **60** (1540): 19, 1924.

The extraction of the juice by hydraulic pressure

A virus from potato transmissible to tobacco. Phytopathology (Abstract) **15**(1): 46–47, 1925

The transmission of viruses from apparently healthy potatoes. Wisconsin Agric Expt. Sta Res Bull. **63**, 12 p., 1925.

This paper gives the results of experiments which tend "to show that at least two different viruses are commonly, if not universally, present in most standard varieties of potatoes".

Mosaic disease on different hosts. Phytopathology **16**(2): 141–149, 1926.

The author gives evidence that the mosaic of tobacco due to five viruses which can be differentiated by the reaction of other hosts when inoculated with them. They are: 1—ordinary tobacco mosaic, 2—cucumber mosaic, 3—petunia mosaic, 4—speckled tobacco mosaic, and 5—mild tobacco mosaic.

The attenuation of plant viruses and the inactivating influence of oxygen. Science **64**(1652): 210, 1926.

The virus of tobacco mosaic may be attenuated by growing the host at 35 to 37° C. The action is more rapid in sandy than in clay soils.

New virus diseases of tobacco and related plants. Phytopathology (Abstract) **16**(1): 66, 1926.

A record but no description.

Some points of view on the plant virus problem. Phytopathology **16**(10): 745–751, 1926.

The author emphasizes the need of greater knowledge of the specific properties of the viruses.

The classification of plant viruses. Wisconsin Agric. Expt. Sta. Res. Bull. **76**, 16 p., 1927.

This paper gives the results of extensive experimental work from which the author describes ten viruses. The descriptions are based on the reaction of several host plants, resistance to aging, heat and chemicals.

The properties and behavior of potato rugose mosaic. Phytopathology (Abstract) **18**(1): 115, 1928.

Further studies on the attenuation of plant viruses. Phytopathology (Abstract) **18**(1): 156, 1928.

The classification of certain virus diseases of the potato. Wis conson Agric. Expt. Sta. Res. Bull. **87**, 24., 1929.

This paper gives the results of the study of several virus diseases and includes transmission, aging in vitro, thermal death-point, tolerance, influence of chemicals, varietal susceptibility and symptoms which are variable.

---------, & Butler Ogden, W[illiam]

The overwinter of the tobacco mosaic virus. Wisconsin Agric. Expt. Sta. Res. Bull. **95**, 25 p., 1929. (Rev. Appl. Mycol. **9** (3): 207, 1930.)

This paper gives the results of extensive field experiments to determine the relative importance of various methods of overwintering.

———, & **Hoggan, Ismé A[ldyth]**

The challenge of plant virus differentiation and classification. Fifth Int. Bot. Congr. Cambridge **1930**: 379–380, 1930. (Science **73**(1880): 29–32, 1931.)

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"Katahdin" a new variety of mosaic resistant potatoes. Science n. s. Suppl. **75**(1938): 12, 1932.

———, & **Grant, Theodore J.**

The properties of plant viruses from different host species. Phytopathology **22**(9): 741–757, 1932.

"The thermal death points, resistance to aging *in vitro* dilution tolerance, and the resistance to certain chemicals of the viruses of ordinary tobacco mosaic, cucumber mosaic, tobacco ring-spot, and tobacco spot necrosis (potato-rugose mosaic) have been compared in extracts from several species of host plants. The experimental results show that the host species in which the viruses developed did not radically influence the constancy of the properties of each virus. Some minor influences were noted that are hardly to be regarded as of sufficient magnitude to be of actual significance.

The contentions that have previously been made in the literature that plant viruses may be fundamentally changed by the host plant affected and that the properties of viruses cannot be adequately studied in a comparative way with the ordinary technique are consequently not supported by the results secured. It is believed that the properties of artificially transmissible plant viruses offer one of the most convenient and reliable criteria for their isolation, differentiation and classification.

Cucumber mosaic on tobacco in Wisconsin. Phytopathology (Abstract) **23**(3): 311, 1933.

Report of field observations. The author points out the occurrence of cucumber mosaic in an epidemic form on tobacco. Appears on the basis of past field records to be unusual.

Johnston, John R[obert,] & Stevenson, John A[lbert]

Fungi and diseases of sugar cane in Porto Rico. Journ. Dept. Agric. Porto Rico **1**(4): 228–233, 1917.

Brief notes: Early account of the occurrence of mosaic disease of sugar cane (called mottling) in Puerto Rico.

———, & **Ashby, S[ydney] F[rancis,] Bancroft, C[laude] K[eith] Nowell, W[illiam] & Stevenson, John A[lbert]**

Diseases of sugar cane in tropical and subtropical America, especially the West Indies. West Indies Bull. **16**(4): 298–300, 1918.

Brief notes on sereh and mosaic disease of sugar cane, the first in Java and the second in Puerto Rico. Description of both diseases.

The new cane disease in Cuba. The Louisiana Planter & Sugar Mfg. **63**(6): 43, 1919.

The author declares that at least the disease is present in three provinces. Quarantine measures are recommended. The author discusses also the history of the disease in other countries.

La enfermedad "Mosaico" de la caña de azúcar. (The disease "mosaic" of sugar cane.) Sección de Sanidad Vegetal, Cuba, Circ. No. **6**, 11 p., 1919.

The author gives popular discussion and recommendations.

The mosaic disease of sugar cane in 1923. (A discussion of the problem to data.) United Fruit Co., Agric. Res. Dept. Pamphet, 35 p., 1923. (Louisiana Planter **73**(1): 10–11, (2) 30–32, (3)49–52, 1924. The Int. Sugar Journ. **26**: 469–473, 1924. A Rev. by C. A. Barber in Rev. Agric., Porto Rico **13**: 265–272, 1924.)

A popular but very comprehensive discussion of this disease.

Control of sugar cane mosaic. Louisiana Planter **74**(10): 190–191, 1925.

The disease spreads slowly in Cuba. Control by inspection and roguing is recommended.

Joly, R. L.

Les conséquences de la mosaïque du manioc. (The effects of Cassava mosaic.) Rev. de Bot. Appl. et d'Agrid. Trop. **11**(114): 99–104, 1931.

On *Manihot utilissima* and *M. dulcis*. The former is the more resistant.

Jones, F[red] R[euel,] & Granovsky, A[lexander] A[nastacievitch]

Yellowing of alfalfa caused by leafhoppers. Phytopathology (Abstract) **17**(1): 39, 1927.

Jones, G. H[oward,] & Mason, T. G.

On two obscure diseases of cotton. Ann. Bot. **40**:(160): 759–771, 1926.

Description of two diseases of cotton in Nigeria, "leaf curl" and "leaf roll". "Leaf curl" is a virus disease, while "leaf roll" is not infectious and is caused by excessive soil humidity.

Jones, L[eon] K[ilby]

The effect and the rate of spread of "streak" on greenhouse tomatoes. Phytopathology **20**(10): 851, 1930.

Virus diseases of raspberry in Washington. Washington State Hort. Assoc. Proc. **26**: 196–199, 1930.

The mosaic disease of beets. Washington Agric. Expt. Sta. Bull. **250**, 16 p., 1931.

The author discusses briefly the general aspects of the disease, concluding that it is not in the soil and is transmitted by the mother beets. Curly-top is also present in Skajit County. Mosaic disease is also reported in garden beets, sugar beets, mangels and spinach.

A new method of inoculating with viruses. Phytopathology (Abstract) **22**(12): 998–999, 1932.

The sources of the viruses that causes streak of tomato. Phytopathology (Abstract) **22**(12): 999, 1932.

Caused by a combination of latent potato virus and common tobacco mosaic.

_____________, Anderson, E. J., & Burnett, G[rover]

(The latent virus of potatoes.) Phytopath. Zeitschr. **7**(1): 93–115, 1934.

Jones, Lewis R[alph] & Shear, C[ornelius] L[ott]

False blossom of cranberries. Wisconsin Agric. Expt. Sta. Bull. **240**, 1914.

A report upon false blossom and other cranberry maladies. Wisconsin State Cranberry Growers' Ass'n Ann. Rpt. **27**: 13–14, 1914.

Soil temperature as a factor in phytopathology. Plant World **20**: 229–237, 1917.

_________, Miller, M[aude] & Bailey E[rnest].

Frost necrosis of potato tuber. Wisconsin Agric. Expt. Sta. Res. Bull. **46**, 1919.

Experimental work on the relation of soil temperature to diseases in plants. Wisconsin Acad. Sci. Arts & Letters. Trans. **20**: 433–459, 1922.

_________, Johnson, James & Dickson, J[ames] G[eere]

Wisconsin studies upon the relation of soil temperature to plant diseases. Wisconsin Agric. Expt. Sta. Res. Bull. **71**, 1926.

————————, & **Riker, Regina [Emma] S[tockhausen]**

Progress with the control of aster wilt yellows. Phytopathology (Abstract) **19**(1):101, 1929.

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Further progress with the control of aster wilt and yellows. Phytopathology (Abstract) **20**(1):129, 1930.

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Wisconsin studies on aster diseases and their control. Wisconsin Agric. Expt. Sta. Res. Bull. **111**, 39 p., 1931.

This publication includes a very complete discussion of aster yellows and its control.

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The oldest known plant virus disease. Science. n.s. **75**(2052): 385, 1934.

This is a review of M. B. Mc Kay and M. F. Werner's Historical sketch of tulip mosaic or "breaking".

Jones, Philip M[allory]

A Mycetozoan found in tobacco plants with mosaic-like symptoms. Phytopathology (Abstract) **16**(1):67, 1926.

Structure and cultural history of a mycetozoan found in tobacco plants with mosaic-like symptoms. Bot. Gaz. **81**(4):446–459, 1926.

The author gives results of studies which lead him to believe that tobacco mosaic is due to an organism which he describes under the name of *Plasmodiophora tabaci.*

Parasite Calkinsi on *Plasmodiophora tabaci* and its possible etiological role in tobacco mosaic. Arch. Protistenk. **62**(2–3): 307–312, 1928.

The author describes an unidentified parasite which he believes to be the cause of the mosaic.

Jones, Walter, & Rawlins, T[homas] E[lsworth]

Influence of spindle-tuber disease on the physiology of the potato tuber. Phytopathology (Abstract) **19**(12):1137, 1929.

Jordi, Ernst

(Report on plant diseases.) Jahresber Landw. Schule Rütti, **1909–10**: 108–114, 1910.

Die Blattrollkrankheit der Kartoffel. (The leaf roll disease of potatoes.) Jabresher. d. Landw. Shule Rütti-zollikofen 1916–18. Anzew Bot. **1**: 216, 1919.

Die Blattrollkrankheiten der Kartoffel. (Leafroll diseases of potato.) Mitteil. Naturf. Ges. Bern. (Abstract) **1922**: 36–37, 1923.

Jorstad, I[van]

Beretning om plant ensykdommer i land og havebruket 1920–23. II Frikttraer og haervekster. (Report on plant diseases in agriculture and horticulture in 1920–23. II Fruit trees and small fruits.) Cristiania Grondahl and Sons Boktrykkeri, 73 p., 1923.

A record of cultivated raspberry mosaic.

Jorgensen, C. A., & Nielsen, O[laf]

Kartoffelsorter og Kartoffelsygdomme. Orienterende undersgelser. (Potato varieties and potato diseases. Preliminary investigations.) Tidsskr for Planteave **39**(2): 295–315, 1933.

A detailed and tabulated account is given of the authors' investigations in Denmark for five years, on the reaction of some standard varieties to late leaf roll, mosaic and other diseases.

Kaiser, P.

Die Blattrollkrankheit der Kartoffel. (The leaf roll disease of potato.) Prakt. Ratgeb. Obstr-u Gartenbau **37**: 387–388, 1922.

Kamerling, Z[eno]

Onderzoekingen over onvodoenden groei ontijdig afsterven van rilt als gevlg van wortelziekten. Meded. van het Proefstation Suikerriet West Java *No* **48**, 1900.

De gele-strepensiekten der bladeren. (The yellow stripe disease of the leaves.) Proefstation Suikerriet West Java "Kakok" to Pekalongan, Verslag. **1902**: 76–81, 1903.

Karunakara Menon, C.

Does fire, or exposure of trees growing under shade, or damage to hosts lead to spike disease in sandal? Indian For. **45**: 498–500, 1919.

Kasai, Mikio

(Observations and experiments on the leafroll disease of the Irish potato in Japan.) Ber. Ohara Inst. Landw. Forsch, **2** (1): 47–77, 1921.

Gives a history of the disease in Japan.

(Mosaic disease of cucumber.) Agric. Lec. **5**: 42–71, 1923.

Investigations on the Nelson's Bodies as observed in the leafroll, mosaic and healthy plants. Ber. des Ohara Inst. Landw. Forsch. in Kuraschiki, Japan. (English trans.) **2**(4): 443–461, 1924.

The author gives a review of the literature and the results of his studies on bodies found in the phloem tissues. He believes these bodies to be disentigrating nuclei.

(Studies on the potato leafroll.) Japanese Dept. Agric. & Forsch. Bur. Agric. Mycol. & Entom. Bull. **17**, 70 p., 1926.

Kellerman, K[arl] F[rederic]

Leaf-cut or tomosis of cotton seedlings. U. S. D. A. Ann. Rpt. p. 159, 1918. (Br. of Plant Indust. Rpt. for 1918, p. 25.)

Phony disease of peach. U. S. D. A. Br. Plant Indst. Plant Dis. Rept. **14**(17): 171, 1930.

A record of occurrence of this disease.

Kelly, N. L.

Bureau of Sugar Experiment Station. Assistant Plant Pathologist, Report. Australia Sugar Journ. **18**(3): 171, 172, 1926. (Rev. Appl. Mycol. **5**: 696–697, 1926. Queensland Agric. Journ. 26(2): 115, 1926.)

Contains a brief discussion of mosaic of sugar cane and other diseases.

Assistant Pathologist Report. The Australian Sugar Journ. **18** (5): 277–278, 1926.

Mosaic disease in cane. Sugar **18**(3): 171–172, 1926. (Queensland Agric. Journ. **25**(6): 498, 499, 1926.)

Bureau of Sugar Experiment Station. Cane pests and diseases. Queensland Agric. Journ. **26**(2): 115, 1926.

Cane pests and diseases. Queensland Agric. Journ. **27**: (2): 82, 83, 96, 98, 1927. (Rev. Appl. Mycol. **6**: 375, 376, 1927.)

Kendrick, James B[lair,] & Gardner M[ax] W[illiam]

Soybean mosaic seed transmission and effect of yield. Journ. Agric. Res. **27**(2): 91–98, 1924.

The disease is transmitted through the seed. It reduces the yield of seed. The seed from diseased plants do not germinate well.

Kerling, L[ouise] C[atharina] P[etronella]

Microscopich onderzoek van pseudonet-necrose en Kringerigheid van de Aardappel. (Microscopic investigations of pseudo-net necrosis and "Krigeriheid" of the potato.) Meded. Landbouwhooschool Wageningen. **33**(10): 17, 1929. (Rev. Appl. Mycol. **9**: 477. 1930.)

The first disease is transmitted in the seed. The second occurs on certain soils. The microscopic characters are very similar.

Microscopic investigations of pseudonetnecrosis and Krigerigheid of the potato. Phytopathology (Abstract) **20**(1): 138, 1930.

The anatomy of the "Kroepoek-diseased" leaf of *Nicotiana tabacum* and of *Zinnia elegans*. Phytopathology **23**(2): 175–190, 1933.

A detailed description of the writer's observations in his anatomical studies on tobacco and zinnia leaves received from Java, which were affected by "common" and "transparent" types of "Kroepoek" (leaf curl).

Keur, John Y.

Seed transmission of the virus causing variegation of abutilon. Phytopathology (Abstract) **23**(1): 20, 1933.

Studies of transmission of the virus causing variegation in *Abutilon thompsoni* and *A. mulleri* in seedlings produced by crossing these two species.

Partial recovery and immunity of virus-diseased abutilon. Phytophathology (Abstract) **24**(1): 12–13, 1934.

King, C[harlmers] J[ackson] & Loomis, H[arold] Frederic

Factors influencing the severity of the crazy-top disorder of cotton. U. S. D. A. Bull. **1484**, 21 p., 1927.

Kinney, Addison

Cane diseases in the Hawaiian Islands. The Planter & Sugar Mfg. **76**(10): 191–192, 1926. (Rev. Appl. Mycol. **5**: 518, 1926.)

Studies and estimate of losses due to mosaic.

Krickner, Emil Otto, Oskar von

Die blattrollrankheit der kartoffeln. (The leafroll disease of potatoes.) Deutsche Landro Presesse **45** *No.* 14, 1919. (Ztschr. Pflanzenkranklr. **29**: 54, 1919.)

Discussion of symptoms of true potato leafroll and separating it from other diseases. Cause not found.

Kirk, T[homas] W[illiam]

Potato diseases. New. Zeal. Dept. Agric. Ann. Rpt. **13**: 346–363, 1905.

Kirkpatrick, T[homas] W[infrid]

Preliminary note on leaf-crinkle of cotton in the Geriza area. Sudan. Bull. Ent. Res. **21**(2): 127–137, 1930.

Control experiments indicated that a white fly (*Aleurodidae*) is the vector. Experiments with *Empoasca fascialis*, gave negative results.

Leaf-curl in cotton. Nature **125**(3157): 672, 1930. (Rev. Appl. Mycol. **9**: 590, 1930.)

A disease of long staple cotton in the Sudan region appears to be caused by a virus and is transmitted by a species of *Aleurodidae*.

Further studies of leaf-curl of cotton in the Sudan. Bull. Ent. Res. **22**(3): 323–363, 1931.

The author adopts the name "leaf-curl" which is manifested by symptoms of "leaf-crinkle" on some varieties of cotton and mosaic on others. Crinkle is transmitted by white flies (*Bemisia gossipiperda*). It attacks *Hibiscus esculentus*, *H. cannabinus*, *H. sabdariffa* and *Altheae rosea*.

Kirschner, R.

Die Blattrollkrankheit des hopfens. (The leafroll disease of hops.) Biol. Generalis Vienna 5: 225, 1929. (Abstract in Fortschr. der Landw. **6**(21): 699–700, 1929. Rev. Appl. Mycol. **9**(2): 131, 1930.)

The author believes that this disease is due to manure.

Klapp, E. L.

Ukologie und Abbau der Kartoffel. (Ecology and degeneration of the potato.) Pflanzenzucht. **8**(9): 213–218, 1932.

Brief discussion of the various hypotheses of the etiology of the virus diseases. Gives also considerations of the potato degeneration problems in relation to the ecology in German and full details of a system of experimentation.

Der Abban der Kartoffel als Folge von Leistungsiibers—pannungen. (Potato degeneration as a sequel to overtaxation of the productive capac'ty.) Pflanzenbau Pflanzenschutz u. Pflanzenzucht. **10**(4):129–146, (5):161–197, 1933.

Continuation of previous work and observations in which the author develops his theory of an ecological basis for potato degeneration.

Klebahn, Henrich

Ueber eine Krankhafte Veränderung der *Anemone memorosa* L. und über inen in den Drüsenhaaren derselben Pilz. Ber. D. Bot. Ges. **15**:527–536, 1897.

Virus Krankheiten. (Virus diseases.) Plant **6**(1):43–63, 1923.

Die Alloiophyllie des *Anemone nemorosa* und ihre vermutliche ursache. (Alloiophylly on *Anemone nemorosa* and its probable cause.) Planta Arch. Wiss. Bot. **1**(4):419–440, 1926. (Ztschr. Wis. Biol. Abt. Ber. Deussche Bot. Gesellech **43**(32)–(37), 1926.)

Reports the finding of bacteria-like bodies in the cells. The disease is transmitted through the soil.

Ueber viruskrankheit und Alloiophyllie. (mit Demostrationen.) (Virus diseases and alloiophylly.) Naturwissenschaften (Abstract.) **16**(45–47): 1002, 1928.

Auschluss an alloiophyllie und viruskrangheiten. Plants **5**:49–73, 1928.

Experimentalle und cytologische untersuchungen im anschluss an alloiophyllie und viruskrankheiten. Ztschr. Wiss. Biol. Abt. E. Planta **6**(1):40–95, 1928.

The author describes the symptoms of alloiophylly a disease of *Anemone nemorosa.* The disease was produced by inoculation with filtered juice. The author also made a study of cell inclusions which be classified as follows; 1—amoeboid bodies; 2—thread-like bundles, and 3—striated bodies, all of which are founded in the phloem of both healthy and diseased plants; 4—trypanoplasts which are found in both healthy and mosaic potato and *A. thompsoni.*

On scolecosomes and on similar bodies in mosaic diseased plants. Proc. Int. Congr. Plant Sci. (Ithaca, N. Y.) **1929**: 1243–1248, 1929.

When *Anemona ranunculoides* and *A. tripolia* were inoculated with juice from *A. nemorosa*, scolecosomes were produced. Similar bodies were found in several other plants infected with virus diseases.

Fortsetzung der experimentallen Untersuchungen uber alloiophyllie und Viruskrankheiten. Phytopathology Ztschr. **4**(1) :1–36, 1931.

Efforts to cultivate tobacco mosaic virus gave negative results. The precipitate in sealed tubes for one year gave positive results when inoculated into plants.

Klemm, M. J.

Mosaikkrankheiten der kulturpflanzen. (Mosaic diseases of cultivated plants.) Ostenrop. Landw. Ztschr. **9**(11) : 1932.

Knight, Thomas Andrew

On the prevention of the disease called curl in the potato. Hort. Soc. (London) Trans. **2**: 64–67, 1819. (Munster Farmers' Mag. **4**: 68, 1816.)

Knorr, P.

(Diseases of potatoes and their control.) Arb. Forschungsinst. Kartoffelban **4**: 68–75, 1920.

(Potato diseases and their control.) Arb. Forschunsinst. Kartoffelban **6**: 114–121, 1922.

Knowlton, George F[ranklin]

Beet leafhopper and curly-top situation in Utah. Utah. Agric. Expt. Sta. Circ. **65**, 12 p., 1927. (Facts About Sugar **22**(32) : 768, 1927.)

The beet leafhopper in Utah. A study of its situation and the occurrence of curly-top. Utah. Agric. Expt. Sta. Bull. **205**, 23 p., 1928. (Rev. Appl. Mycol. **9**(1) : 9, 1930.)

A popular discussion of the transmission of the curly top of the sugar beet by *Eutettix tenella*.

Studies on the morphology of the beet leafhopper *Eutettix tenellus* (Baker.) Utah Agric. Expt. Sta. Bull. **212**, 24 p., 1929.

Studies on the beet leafhopper (*Eutettix tenellus*) Proc. Utah. Acad. Sci. **7**:57–58, 1930.

The beet leafhopper in northern Utah. *Eutettix tenellus.*) Utah Agric. Expt. Sta. Bull. **23**, 64 p., 1932.

This paper does not deal with virus diseases but is interesting because the insect is a vector of the curly-top of the sugar beet.

Kobus, J[acob] D[erk] & Bokma de Boer, B.

Selecttie van het Suikerriet. (Selection of sugar cane.) Arc. voor de Java Suiker Indust. p. 289–319, 1902.

Studien uber die Ursache der Blattrollkrankheit der Kartoffel und uber die Moglichkeit der Uebertraugung dieser Krankheit durch das Saatgut und den Boden. (Studies on the cause of leafroll disease of potato and on the possibility of transmission of this disease by means of seed and soil.) Ztschr. Landw. Ver. Osterr. **14**(5) : 759–805, 1911.

---------, **Broz, O[tto]**

Bericht uber die van der K. K. Pflanzenschuzstation im Jahre 1911 durchgefuhrten Versuche zum studium der Blattrollkrankheit der Kartoffel. (Report on the K. K. Plant Protection Station in the year 1911, about the experiments conducted on the studies of leafroll diseases of the potato.) (Mitteilungen des Komitees um Studium der Blattrollkrankheit der Kartoffel, *No.* **5**. (Memoir of the committee for the study of the leafroll disease of potato. No. **5**.). Ztschr. fur Landw. Ver. Osterr. Jahrg. **15**(3) 179–247, 1912.

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Ueber Blattrollkrankheit der Kartoffel VI. (Leafroll disease of the potato VI.) Ztrchr. Landw. Ver. Osterr. **16**(3) : 140, 1923. (Bot. Centralbl. (Abstract) **123**(8) : 200, 1913.)

(Important potato disease.) Monattish. Landw. **6**(7) : 211–214, 1913.

Ueber dei Blattrollkrankheit der Kartoffel. (Potato leafroll disease.) Wiener. Landw. **64**(41) : 382–383, 1914.

Ueber der Blattrollkrankheit der Kartoffel. (Leafroll disease of the potato.) Zrscht. Landw. Ver. Osterr. **17**(5): 270–300, 1914.

Koch, Karl Lee

The potato rugose mosaic complex. Science n. s. **73**(901): 615, 1931.

Report that the rugose mosaic of the potato is the same as spot-necrosis in tobacco and is caused by a combination of two distinct viruses.

The nature of potato rugose mosaic. Phytopathology **23**(4): 319–342, 1933.

A rather extensive report of the author's experiments, fully discussed and tabulated. He confirms the evidence that rugose mosaic of potato is due to a combined action of the mottle virus normally present in healthy potatoes with "veinbanding".

Kock, G[ustav], & Kornauth, K.

Studien über die ursachen der Blattrollkrankheit der Kartoffel und über die Möglichkeit der Uebertragung dieser Krankheit durch das Saatgut und den Boden. Zeitschr. Land. Versuchsw. Oesterr **14**: 759–805, 1911.

Unsere gegenwärtigen Kenntnisse über die Blattrollkrankheit. (Our present knowledge on the leaf roll disease.) Monat. Landw. **2**: 379–383, 1909.

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Beiträge zum Studium der Blattrollkrankheit. (Contribution to the studies on leafroll disease.) Monat. Landw. **3**: 365–369, 1910.

Die Blattrollkrankheit der Kartoffel. (The leafroll disease of potato.) Zeitschr. Landw. Versuchsw. Oesterr. **14**: 737, 1911.

Die Blattrollkrankheit der Kartoffel. (The leafroll disease ot potato.) Wien Landw. Zeitg. **64**: 382–383, 1914.

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Studien über die Blattrollkrankheit der Kartoffel. (Studies on the leaf roll disease of potatoes.) Zeitschr. Landw. Versuchsw Oesterr. **17**: 270–300, 1914.

Masseanauless als Mittel gegen den Abbau. (Mass selection as a remedy for degeneration.) Osterr. Erscht. fur Kartoffelbau, p., 45–47, 1930.
Popular.

Die "Viruskrankheiten" der Kartoffel. (The virus disease of the potato.) Osterr. Zrster. für Kartoffelbau No. **2**, 3 p., 1927.

Keeslag, F. D.
Die Kartoffelarkenung in Holland. Mitt. Deustch. Landw. Geselch. **14**(23): 505–508, 1930.
Potato seed selection for the gradual elimination of virus disease.

Kofoid, Charles A[twood], Severinin, H[enry] Herman P[aul,] & Swezy Olive.
Nelson's spiral bodies in tomato not protozoans. Phytopathology, **13**(7):330–331, 1923.
This paper gives the results of the studies of both normal and diseased plants. Protozoan like bodies were found in both and it was demonstrated that they were not trypanosomas.

Köhler, E[rich]
Stellungnahme zum Problem for Kartoffelbans. Die Kartoffel **10**:159–160, 1930.

Allgemeines uber viruskrakheiten bei pflanzen. (General information on virus diseases of plants.) Angew. Bot. **14**(4): 334–348, 1932.
A general review of the subject.

Die Rolle der Viruskrankheiten beim Kartoffelabbau. (The role of the virus diseases in potato degeneration.) Angew. Bot. **15**(2):122–131, 1933.
The author states that the most important virus disease of potato in Europe, without a doubt is leaf roll, followed by K. M. Smith's X and Y, Murphy's and McKay's A and Köhler B 77 and H 19.

Untersuchugen über die Viruskrankheiten der Kartoffel. I Versuche mit Viren aus der Mosaikgruppe. (Investigations

on the virus diseases of the potato. I Experiment with viruses of the mosaic group.) Phytopath. Zeitschr. 5(6):567–591, 1933.

A detailed account of the author's studies on the nature of five viruses isolated in Germany from potatoes, designated as M 23, M 29, H 19, R 77 and GA. Tests of these viruses were made on various hosts. Results are given.

Viruskrankheiten au Tomaten und Gurken unter Glas. (Virus diseases of tomatoes and cucumbers under glass.) Nachrichtenbl. Deutsch, Zenschutzdienst, 13(2): 11–13, 1933.

Brief review of the knowledge of the virus diseases of tomatoes and cucumbers occurring in glasshouses.

---------- Ein latentes Kartoffelvirus. (A latent potato virus.) Naturwissensch 21(31): 578, 1933.

Report of the observations and results attained by the author studying the virus from an apparently health potato transmissible by rubbing with tobacco, which is termed E 8.

Untersuchgen über die Viruskrankheiten der Kartoffel. II Studien zur Blattrollkrankheit. (Investigations on the virus diseases of potatoes. II. Studies on leaf roll disease. Phytopath. Zeitschr. 6(4): 359–369, 1933.

Continuation of previous work on potato leaf-roll disease. Transmission studies by means of the aphid *Myzus persicae*.

Kohler, E.

Die Viruskrankheiten der Kartoffel. (The virus diseases of the potato.) Biol. Reichsanst. für Land-und Fortwirtsch. Flugbl. 42, 4 p., 1933.

Brief popular account on the occurrence, etiology and control of leaf-roll mosaic, leaf curl and streak of potatoes in relation to degeneration in Germany.

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Koning, C[ornelia] J[ohan]

Hollandasch Tabak. De Nature 17: 368–373, 18: 322–339, 357–366, 1898.

Die Fleckenoder Mosaikkrankheit der Hollandischen Tabaks. (The spot or mosaic disease of Holland tobacco) Ztschr. Pflanzenkarnk Bd **9**(2) 65–80, 1899

Koningsberger, V. J.

Fidji-ziekte op Java (Fiji disease in Java) Arch voor de Java Suikerindus **38**(25) 581–584 1930 (Rev Appl Mycol **10** (1) 58–59 1931)

Notes on the observation of the occurrence of "Fiji" disease on canes imported from the Philippines, C A. 12735 and C. 17. In the Philippines the most susceptible varieties are P. O J. 288 and DI 52.

Kopp, A[ndré]

(Peanut rosette) Rev Bot Appl & Agric Colon **4**(30) : 129, 1924

La mosaique de la canne de sucre (The mosaic of the sugar cane disease) Rev de Bot Appl **5**(46) 411–417, (47) 519–526, 1925 (Rev Appl Mycol **5**(1) 2, 1926 Sta Agrom Guadalupe Tech Bull No **1**, 1926 Rev Appl Ent ser A **13** 530 1926

A general discussion of the subject

La mosaique de la canne a sucre (The mosaic of sugar cane) Rev Agric Ile Réunion (10–14) 6–8, 1926

Un cas de longue incubation de la mosaique de la canne a sucre (A case of long incubation of sugar cane mosaic) Rev Bot Appl et d'Agric Trop **11**(113) 37–39, 1931

The author gives the observations on the slow spread of the disease

———, **Emmerez de Charmoy, D[onald] d'**

Nouvelles constatations sur la maladies a virus de la canne á sucre et du mais (New evidence about the virus of sugar cane and corn) Compt Rend Acad Sci (Paris) **193** 875, 1931

Observations nouvelles concernant la mosaique de la canne á sucre et la Streak du mais (New observations concerning sugar cane mosaic and corn streak) Sta Agrom Ile de la Réunion. Travaux Tech. Bull. **3**, 10 p., 1932.

A brief description of the topography of the island. Owing to natural barriers it is impossible for the mosaic to pass from leeward

to windward part of the island except by the aid of man. The mosaic was introduced 15 or 20 years ago, probably from Java. The disease has spread more abundantly on the leeward. Varieties Luizir and Post Mackay are very susceptible. Best varieties are disappearing because of mosaic and gummosis. Mosaic is carried by cuttings and by *Aphis maidis* which is abundant. Restricted to a relatively small area on the windward side. Difficult to understand why it is not more general on the windward side. Experimental work at the Station indicates that the disease may be dormant for very long periods of time. Streak is most common in Uba. Also occurs on other canes and corn but is rare on most canes except Uba and R. P. 8. It is transmitted from *Coix Lachryma jobi* to R. P. 6, by *A. maidis*. This is contradictory to results of Storey. Uba is more susceptible to virus from Uba than to virus from corn. Virus from Uba and corn does not appear to infect *Eleusine indica*, but the virus from POJ 213 does infect *E. indica*. The virus is carried by *A. maidis* from corn to corn and from cane to cane. It is also carried from *Coix Lachryma jobi* to cane. Cane growing near corn which is badly infected with the streak and infected with *A. maidis* did not contract the disease. This was also true of oats. *Coix Lachryma jobi* and some grasses appear to be reservoirs for the virus.

Situation actuelle de la mosaïque de la canne á la Réunion. (Actual situation of sugar-cane mosaic in Reunion. Travaux Tech. Ile de la Réunion, Bull. 3: 11–19. 1932.

A discussion of the distribution and importance of the importation of canes.

Kornauth, K[arl,] & Reitmair, O[tto]

Die Blatrollkrankheit der Kartoffel und ihr Auftreten in Oesterreich. (The leafroll disease of potato and its occurrence in Australia.) Monastshefte fur Landw. Jahrg. 2(3): 79–90, 1909.

Studien uber die Blattrollkranheit der Kartoffel. (Studies on the leafroll disease of the potato.) Mit besonderer Berucksightigung ihres Auftreten und ihrer Vervreitung 1908 in Osterr. Ztschr. Landw. Versu. in Osterr. Jahrg. 3(3) :97–125, 1909.

Kostoff, D.

(Virus diseases causing sterility.) Phytopath. Zeitschr. 5(6): 593–602. 1933.

Report of the author's observations on certain abnormalities of the reproductive organs on some species and hybrids of *Nicotiana*, induced by virus diseases. He denominates the virus causing sterility "female sterility virus".

(A contribution to the sterility and irregularities in the meiotic processes caused by virus diseases.) Genetica **15**(1–2): 103–114. 1933.

Continuation of the previous work of the author at Leningrad on the female sterility virus of tobacco.

Kotila, J[ohn] E[rnest]

Mosaic and potato yields in Michigan. Michigan. Agric. Exp. Sta. Quart. Bull. **5**(4): 188–189, 1923.

The author reports a loss of 32 per cent due to mosaic.

————, & **Coons, G[eorge] H[erbert]**

Trypanosome-like bodies in Solanaceus plants. Phytopathology **13**: 324–326. 1923.

This paper gives the results of studies of mosaic and normal plants. The authors found protozoa-like bodies in both but they do not believe them to be protozoa.

Transmission studies of virus diseases of potato in Michigan, 1926–27. Potato Ass'n. Amer. Proc. **14**: 95–101, 1927.

A review of contribution to potato pathology which appeared in American publications during year, 1927. Potato Ass'n. Amer. Proc. **14** 226–232. 1927.

Roguing and potato virus disease control. Potato Ass'n. Amer. Ann. Meetg. Proc. 16th. **1929–30**: 164–168, 1930. (Rev. Appl. Mycol. **9**: 551, 1930.

This paper gives the results of roguing for the control of these diseases. The percentage of virus disease in the next crop was very high; mosaic and leafroll the highest. The author believes that *Solanum dulcamara* and *Physalis grandiflora* were sources of infection.

Experiments with the tuber index method of controlling virus diseases of potato. Michigan Agric. Expt. Sta. Bull. **117**, 26 p., 1931.

A description of methods and results of experimental work.

Kottman, G.

The sereh cane disease. Sugar Cane **23**: 313–317, 1891.

Kramer, S[imon] P[endleton]

Experiment with bacterial filters and filterable viruses. Science **65**: 46, 1927

A brief account on the subject in general but not especially on plant viruses.

Krantz, F[red] A[lbert,] & Bisby G[uy] R[ichard]

Relation of mosaic to running-out of potatoes in Minnesota. Minnesota Agric. Expt. Sta Bull. **197**, 31 p., 1921.

Gives the history, symptoms and methods of transmission of this disease. Also field experiments to determine effect on yields.

Kranzlin, G[ottfried]

Untersuchungen an Panaschierten Pflanzen. (Investigations on variegated plants. Zrscht. Pflnazenkrank. **18**: 193–203, 1908.

A record of spectroscopic studies.

Kraybill, Henry R[esist,] & Eckerson, Sophie, H[ennion]

Tomato mosaic. Filtration and inoculation experiments. Amer. Journ Bot. **14**(8): 487–495, 1927.

Used a fritted glass filter and secured (1) a residue which produced mosaic, and (2) a filtrate which produced a fern leaf.

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Separation of fern leaf from mottling in tomato mosaic. Phytopathology **17**(1): 57–58, 1927.

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The separation from mosaic tomato plants of toxins which produce some of the typical symptoms. Phytopathology (Abstract) **19**(1): 108, 1929.

A non-infectious leaf-deforming principle from mosaic tomato plants. Phytopathology, **22**(7): 629–636, 1932.

The authors induced a filiform leaf on tomato plants by heavy inoculations with preparations made from tomato plants but which was non-infectious for mosaic. Later growths were normal. The abnormality was not produced with preparations from healthy tomato plants.

Krüger, K.

Beiträge zur Physiologie der Blattrollkrankheit der kartoffel. (Contribution about the physiology of the leafroll disease of potato.) Wiss. Arch. Landow A. Arch. Pflanzenzan **9**(3): 496–524, 1932.

Krüger, W.

Vorläufige Mitteilungen über die sogenannte "Serehkrankheit" des Zuckerrohres. Ber. Versuchstat. Zuckerrohr. in West-Java, Kagok–Tegal (Java) **1**: 126–179, 1890.

Weitere Mitteilungen über die Serehkrankheit der Zukerrohres zur Belenchtung des Standes der Serehfrage Ber. Versuchsstat

Zuckerrohr in West–Java, Kagok–Tegal (Java) **2**: 122–219, 1896.

Extensive review of literature on sereh disease.

Ueber die Ursache der Serehkrankheit des Zucherrohres. Eine Kritik der Arbeit und Theorie von Wakker. (On the cause of sereh disease of sugar cane. A criticism of the work and theory of Wakker.) Deutsche Zuckerind. **23**: 225–235, 1898.

Kufferath, H., & Ghesquiere, J[ean]

La mosaïque du manioc. (Mosaic of Cassava.) Compt. Rend. Soc. de Biol. **109**(12): 1146–1148, 1932 (Ann. de Gembloux **38**(11): 365, 1932.)

The authors report a second mosaic disease of *Manihot utilissima*, *M. aipi* and *M. glaziovii*. It is transmitted by an *Aleurodidae*. The record is from Belgian Congo.

Kulkarni, G[okal] S[ubras]

Mosaic and other related disease of crops in the Bombay Presidency. Poona Agric. Coll. Mag **16**(1): 6–12, 1924.

Kunkel, L[ouis] O[tto]

A possible causative agent for the mosaic disease of cane. H. S. P. A. Expt. Sta. Bot. ser. Bull. **3**(1): 44–58, 1921. (Science n.s. **55**: 73, 1928. Arch. Java Suikerindus. **1922**: 356, 1922.)

Gives symptoms, distribution, varietal resistance and a very thorough discussion of the intracellular bodies which the author believes to be the cause of the disease.

A possible causative agent for the mosaic disease of corn. H.S.P.A. Expt. Sta. Bot. ser. Bull. **3**(1): 1–14, 1921.

Mosaic of sugar cane. Louisiana Planter **69**(25): 442–443, 1922.

Popular.

Mosaic disease on a new grass host. Hawaii Planters' Rec. **26**(3): 163, 1922.

Insect transmission of yellow stripe disease. Hawaii Planters' Rec. **26**(2): 58–64, 1922. (Archiv. Java Suikerind. **30**(21): 357–358, 1922.)

Amoeboid bodies associated with *Hippeastrum* mosaic. Science **55**: 73, 1922.

Studies on the mosaic of sugar cane. H. S. P. A. Bull. Expt. Sta. Bot. ser. **3**(2): 115–167, 1924. (Rev. Appl. Mycol. **3**: 607–608, 1924.)

Discusses the nature of the disease, method of transmission to other host, effect of sun light and extensive studies on effects on commercial varieties.

Further studies on the intra-cellular bodies associated with certain mosaic diseases. H. S. P. A. Expt. Sta. Bot. ser. Bull. **3**(2): 108–114, 1924. (Rev. Appl. Mycol. **3**: 598, 1924.)

Discusses the intra-cellular bodies in several species of plants.

Insect transmission of aster yellows. Phytopathology (Abstract) **14**(1): 54, 1924.

Histological and cytological studies on the Fiji disease of sugar cane. H. S. P. A. Expt. Sta. Bot. ser. Bull. **3**(1): 99–107, 1924.

Studies on the intra-cellular bodies by Lyon. The evidence is not sufficient to determine their nature.

Insect transmission and host range of aster yellows. Science n s. **62**(1614): 524, 1926.

Mosaic and related diseases. Amer. Journ. Bot. **12**(8): 517–521, 1925.

The author discusses question concerning possible causes and methods of transmission and suggests lines of research.

Studies on aster yellows. Amer. Journ. Bot. **13**(10): 646–705, 1926.

Incubation period of aster yellows in its insect host. Phytopathology (Abstract) **16**(1): 67, 1926.

The author gives a description of the disease and experiments proving that it is carried by *Cicadula sexnotata*. It is not carried in seeds. It attacks more than 50 species of plants and overwinters in some of them. The same virus caused the Río Grande or white heart of lettuce, bunchy-top of *Helichrysum* and a disease of buckwheat.

Sterility caused by the aster yellow disease. Amer. Hort. Soc. New York. **3**: 243–244, 1927.

"While most mosaic diseases including those that are seed-borne, do not seriously affect seed viability, aster yellows cause sterility in the China aster and in many other species. Diseased plants may produce no flowers, abnormal flowers and no seed, or seeds that do not germinate."

The corn mosaic of Hawaii distinct from sugar cane mosaic. Phytopathology (Abstract) **17**(1)41, 1927. (Rev. Appl. Mycol. **6**: 438, 1927. Rev. Appl. Ent. ser. A. **15**: 283, 1927.)

Some characteristic of virus disease of plants. Journ. Bact. **13** (1): 23–24, 1927.

Virus diseases of plants In filterable viruses ed. by T. M. Rivers, p., 335–358, 1928.

A very excellent review of our knowledge of the subject to date.

Mayo Foundation Lectures. Lecture on plant pathology in relation to man. p., 17–32, W. B. Saunders Co. Philadelphia, 1928.

Further studies on the host range of aster yellows. Phytopathology (Abstract) **18**(1): 156, 1928.

Wire screen fences for the control of aster yellows. Phytopathology (Abstract) **19**: 100, 1929.

Wilt resistant aster. Phytopathology (Abstract) **19**(1): 100, 1929.

The aster yellows disease. Proc. Intern. Congr. Plant Sci. Ithaca **2**: 1249–1253, 1929.

Transmission of sida mosaic by grafting. Phytopathology (Abstract **20**(1): 128–130, 1931. (Rev. Appl. Mycol. **9**: 385, 1930.)

Transmission of aster yellows to the tomato. Phytopathology (Abstract) **20**(1): 129, 1930. (Rev. Appl. Mycol. **9**: 418, 1930.)

Inoculation period by peach yellows as affected by point inoculation. Science (Abstract) **71**(1846): 516, 1930.

Studies on aster yellows in some new hosts plants. Contr. Boyce Thompson Inst. **3**(1):35–124, 1931.

A record of experimental transmission of this disease to 120 new hosts included in 30 families. The disease had not been transmitted previously to species in 15 of these families.

Local lesions in Aucuba mosaic of tomato. Phytopathology. (Abstract.) **22**(1):16, 1932.

Celery yellows of California not identical with the aster yellows of New York. Boyce Thompson Inst. Contr. **4**(3):405–414, 1932.

The author describes transmission experiments using *Cicadula sexnotata* from aster, celery and carrot plants and concluded that the yellows from California differs from the aster yellows of New York in respect to transmission to celery, no other differences having yet been demonstrated.

Insect transmission of peach yellows. Contr. Boyce Thompson Inst. **5**(1):19–28, 1933.

The author gives the results of experiments with a large number of insects and found that the disease was transmitted by *Macropsis trimaculata*. About 10 per cent of the trees contracted the disease.

Tobacco and aucuba-mosaic infections by single units of virus. Phytopathology (Abstract) **24**(1):13, 1934.

Studies on acquired immunity with tobacco and aucuba mosaics. Phytopathology **24**(5):437–466, 1934.

The author describes the symptoms by which aucuba and tobacco mosaic may be distinguished on *Nicotiana sylvestris*. Then gives a thorough and detailed account of his observations.

Kuribayashi, K.

(On the seed transmission of the bean mosaic.) Journ. Plant. Prot. **13**:199–219. 1926.

(On the relation between the stripe disease of rice plant and *Delphacodes steriatellus* Fall.) Journ. Plant. Prot. **18**:565–571, 636–640, 1931.

(Studies on the stripe disease of rice plant.) Nagano Agric. Expt. Sta. Bull. **2**:45–69, 1931.

Kuster, E[rnst]

Ueber Mosaikpanaschierung und vergleichbere Erscheiungen. (On mosaic varietion and comparable phenomena.) Ber. Destsch. Bot. Ges. **36**: 54–61, 1918.

Not mosaic disease. A discussion on mosaic patterns.

Ueber sektoriable Panaschierung und andare Former der sektorialer. Differenzierung. Monatshefte f. d. Natura. Unters. **12**: 84–87, 1919.

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Zur Atiologie des Panaschierungen. (On the etiology of variegation.) Ztschr. f. Planzenkrankkh. **36**(5/6): 129–142, 1926.

Beiträge zur Kenntnis der panaschierten Geholze. 14–17 Mitt. Dtsch. Deuwl. Ges. Jahrb. p., 258-271, 1926.

Uber Panaschierung. (About variegation.) Proc. Int. Cong. Plant. Sci. (Ithaca, N. Y.) p., 1254, 1929.

Beiträge zur Kenntnis der panaschierten Geholze 31–32. Mitt. Deutsch. Dendrol. Ges. Jahrb. **1931**: 343–348, 1931.

Kuyper, J[an] [1]

Overbrenging van Gelestropenziekte door Insecte. (Transmission of yellow stripe disease by insects.) Arch. voor de Java Indus. **30**: 337–358, 1922.

A discussion of a paper by Kunkel.

Het optreden van strepenziekte in den west-moesson van 1923–24. (The occurrence of stripe disease in the West Monsoon of 1923–1924.) Meded. Proofstat. Java Suiker Indus. **5**:141–150, 1924.

Het optreden van sereh in maalriet-en bibituinen in 1925. Meded. Proefts. Java–Suikerindust. No. **11**: 275–290, 1925.

Warwaterbehandeling van bibit tegen sereh. (Hot water treatment to "bibit" (seed) against sereh.) Arch. Suikerind. Nederl. Indie **33**: 739–743. 1925.

[1] Also appears cited as *Kuijper*.

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Het verband tusschen slijmziekte en voorfgaande hegroeiing in de proef of Padang Boelen. Deli Proefts. Medan Vlugschr. **41**, 5 p., 1927.

Kutín, A[dolf]

(Control of potato diseases in the field.) Ochrana Rostlin, Prag. **5**: 17–19, 1925.

Nomenclature of potato diseases and their causes.) Ochrana Rostlin, Prag. **5**: 27–28, 1925.

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Action des circuits oscillants sur la dégénérescense des Pommes de terre. Compt. Rend. Acad. Sci. **192**(22): 1408–1410, 1931.

Report of experiments with oscillatory circuits on the treatment and prevention of potate degeneracy.

Labo, A.

Terapia di montagna in agricoltura. (Mountain therapeutic in agriculture.) Hiorg. Agric. della Domenica Piacenza **38** (39): 425, 1927.

Lacey, M[argaret] S[owerby]

Protozoa and virus diseases of plants. Nature **112**(2808): 280–281, 1920.

The author reported the finding of protozoa-like bodies in the phloem of mosaic hop plants which resembled those reported by Nelson. She believes them to be degenerate nuclei.

Lackey, C[harles] F[ranklin]

Further studies of the modification of sugar-beet curly-top virus by its various hosts. Phytopathology (Abstract) **19**(12): 1141–1142, 1929. (Rev. Appl. Mycol. **9**: 256, 1930.)

Attenuation of curly-top virus by resistant sugar-beets which are symptomatic carries. Phytopathology **19**(10): 975–977, 1929. (Rev. Appl. Mycol. **9**: 282, 1930.)

The virus is attenuated by passing through resistant varieties.

Virulence of attenuated curly-top virus restored by *Stellaria media*. Phytopathology (Abstract) **21**(1): 123–124, 1931.

Restoration of virulence of attenuated curly-top virus by passage through *Stellaria media*. Journ. Agric. Rech. **44**(10): 755–765, 1932.

Virulent virus of the curly-top of sugar-beet becomes attenuated when passed through *Chenopodium murale*. This is due to a change in quality, rather than quantity. The attenuated virus from *C. murale* can be restored by passing it through *Stellaria media*. Virus from the beet is unchanged by its passage through *S. media*.

Lafrenz, E.

Die Blattrollkrankheit der Kartoffel. (The leafroll disease of potato.) Landw. Wochenbl. Schlesw. Holst. **72**: 645, 1922.

Lamkey, E[rnest] M[ichael] R[udoph]

A consideration of yellows. Amer. Carnation Ass'n. Proc. **26**: 25–35, 1917.

The stomata are closed. There is a reduction in quality or quantity of diastase and an increase in starch and oxidase.

Lang, W[ilhelm]

On the outbreak of the leafroll disease in Wurttemberg. Wurttemb. Wehnbl. Landw. (23): 420–422; 444–445, 1909.

Laphem, M[acy] H[arvey], & Heileman, W[illiam]

Field operations of the Bureau of soils. U. S. Dept. Agric. Soil Survey of the Lower Salinas Valley, California, p. 506, 1901.

Larose, E.

Etat actuel de la culture de la Pomme de terre en Belgique, la possibilité de produire des plantes saines chez nous. (The present situation in potato culture in Belgium, the possibility of producing sound plants by us. Ann. de Gembloux, **32**(2): 265–288, 1926.

Larsen, L. D.

Diseases of the pineapple. Hawaii Sugar Planters' Ass'n. Path. Phys. Ser. Expt. Sta. Bull. **10**, 1910.

The disease at that time was supposed to be due to a *Fusarium*.

Laske, C[arl]

Beitrag zur Kenntnis der Viruskrankheiten der Kartoffelpflanze, (Contribution to the knowledge of virus diseases of the potato plant.) Angewandte Bot. (Abstract) **10**(5): 478–479, 1928.

Latham, H. A.

Spike disease in sandal. Indian For. **44**: 370–372, 1918.

Laubert, R[ichard]

Ueber die Bllattrollkrankheit der Syringen und die dabei auftretende abnorme Starkeanhaufung in den Blattern der Kranken Pfanzen. Gartenflora, **63**: 911, 1914.

Lawrence, W[illiam] H[ereford]

Insect posts and diseases of bush fruits. Better Fruit Mag. **7**: 18, 1912.

Popular.

Leach, J[ulian] G[ilbert]

Leafhopper injury to potatoes. Phytopathology (Abstract) **12**: (1): 37, 1922.

————————, **& Stakman, E[lvin] C[harles]**

Garden truck diseases. Minnesota Agric. Expt. Sta. Rpt. **1922**: 99–100, 1922.

Cucumber mosaic. Minn. Hort. **54**: 177–179, 1925.

Leak, G. D.

The breaking of tulips. Flor. Exch. **67**: 128–129, 1928.

Lebard, P[aul]

Relations entre l'altitude, l'humité et les substitutions de dégénérescence de la Pomme de terre. (Relations between altitude, humidity, and the forms of degeneration of the potato.) Compt. Rend. Acad. d'Agric. de France **16**(30): 999–1004, 1930.

A discussion on the subject based on observations made by the author in the French Alps.

Ledeboer, F.

Gelestrepenziekte. (Yellow stripe disease.) Arch. Suikerindus, Nederland. Indië. Jarg. **29**: 1000–1001, 1921. (Deutschs Sinkerindus. **46**: 501, 1921.)

Gelestrepenziekte. (Yellow stripe disease.) Arch. voor de Java Suiker Indus. **30**(21): 359–362, 1922. (Facts About Sugar **22**: 557–577, 583–588, 769, 839, **24**: 154. 224, 418, 1923. Int. Sugar Journ. **26**: 18–21, 1924. Rev. of Appl. Mycol. **2**: 233, 1923.)

The writer discusses a paper by van Harreveld and gives the results f his own studies with insects.

Ziekten en Plagen. (Diseases and pests.) Verslag Ondera Cheribon, Proefts. Java Suikerindust, p. 12–16, 1922.

Ledingham, J. C. G.
The differentiation of plant virus. Rpt. Proc. *5th.* Int. Congr. Bot. Cambridge. p. 374–379, 1930.

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Yellow stripe disease of cane in the Philippines. Sugar Cent. and Planters' News 1(13) : 36; (14) : 12–17, 1920. (Sugar **23** : 53–54, 1921.)

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Fiji disease of sugar cane in the Philippines. Philippine Agric. Rev. **14** : 413–417, 1921. (Sugar **24** : 676–677, 1922.)

Cane disease in Negroes. Sugar Cent. and Planters' News. **2**(21) : 568–569, 1921.

————, & Kopke, E[rnest] W.
Mosaic disease of sugar cane in the Philippines. Philippine Agric. Rev. **14**(4) : 418–421, 1921. (Sugar Cent. and Planters' News. **4**(9) : 442–448. Rev. Appl. Mycol. **2** : 141. Rev. Appl. Ent. Ser. A. **11** : 348, 1921.)

A history and description of the disease.

————, & Medalla, M[ariano] G.
The seasons' experiments on Fiji disease, mosaic disease and smut of sugar cane. Philipp. Agric. Rev. **14**(4) : 402–412, 1922. (Rev. Appl. Mycol. **2** : 88, 89, 1923. Rev. Appl. Ent. ser. A. **11** : 348, 1923.)

This paper gives the results of field studies with these diseases.

————, & Locsin, Carlos, Montilla, Emilio, & Ocampo, Ricardo
Report of the Committee on cane disease. Philippine sugar Ass'n. Sugar Cent. and Planters' News **4**(10) : 505–520, 1923. (Hawaii Planters' Rec. 30(1) : 38–48, 1926.)

A thorough report of sugar-cane diseases, especially Fiji, and mosaic.

Sereh disease of sugar cane in Singapore. (Phytopathology **13** (3) : 145, 1923.

A record of this disease on canes that had been introduced from Java.

Present needs in cane disease control. Int. Sugar. Journ. **26** (310): 543–545, 1921. (Trop. Agric. **64**: 35–37, 1925. Sugar **26**: 433–434. Id. Abst. (Spanish) **26**: 525, 1925.)

Sugar cane disease. (Digest of the proceedings of the first conference of the International Society of Sugar Cane Technologists, Honolulu, Hawaii **1924**: 9–12, 1925. (The Plant & Sugar Mfg. **74**(11): 210–212, 1925.)

The common grasses in Hawaii in relation to mosaic or yellow stripe disease. Hawaii Planters' Rec. **30**(2): 270–278, 1926.

A list of susceptible grasses.

Estimated damage by mosaic. Ann. Rpt. *7th* Conv. Philipp. Sugar Ass'n 1929. (Facts About Sugar (Abstract) **25**(13): 312–313, 1930.)

————————, & **Medalla M[ariano] G.**

P. O. J. 2878 is susceptible to cane smut. Sugar News. **12**(4): 220–221, 1931.

Tabulation is given of three major cane diseases, in Luzón, Philippines. Smut, mosaic and Fiji. Percentage of susceptibility is given on each variety observed.

Leefmans, S[alomon]

Ziekten en plagen der cultuurgewassen in Nederlandsch-Indie in 1928. (Diseases and pests of economic crops in the Dutch East Indies in 1928.) Meded. Inst. voor Plantenziekten, **75**: 96, 1929. (Rev. Appl. Mycol. **9**(3): 160, 1930.)

Ziekten en plagen der cultuurgewassen in Nederlandsch Oest Indie in 1929. (Diseases and pests of cultivated crops in Dutch East Indies in 1929.) Meded. Inst. voor Plantenziezten **79**. 100 p., 1930.

Leafroll and mosaic on potatoes was prevalent on the east coast of Sumatra.

Lees, A[lan] H[enry]

"Reversion" of black currants. Journ. Bath. West Countries Soc. **5**: 135–138, 1918.

Gives an explanation of the probable causes, which he believes to be due to a checking of the terminal growth.

Reversion and resistance to big bud in black currants. Ann. Rpt. Agric. and Hort. Res. Sta. Long Asliton. Bristol. **5**: 11–27, 1918.

A method of identifying reversion of black currants. Univ. Bristol Ann. Rpt. Agric and Hort. Res. Sta. p., 66–70, 1920.

The association of black currant mite, (*Eriophyes ribis*) with reversion disease. Ann. Rpt. Agric. and Hort. Res. Sta. Long Asliton, Bristol, 1921.

Reversion of black currants: A method of identification. Journ. Ministry Agric. (Great Britain) **27**: 1122–1127, 1921.

A description of the disease.

The association of black currant mite. (*E. ribis*) with reversion disease. Journ. Bath. West and South Co. **5**(16): 237–241, 1922.

Statistical studies on the propagation ot big bud and reversion disease of black currants. Ann. Rpt. Agric. and Hort. Res. Sta. Long Asliton, Bristol. 1922.

The percentage of diseased plants in a season ranged from nothing to 20 per cent.

Leaf character in reverted black currant. Ann. Appl. Biol. **9**(1): 49–68, 1922.

A discussion of symptoms and of agencies that are suspected as being causes of the disease.

Reversion in black currant. Gard. Chorn. III, **72**: 65, 1922.

The influence of reversion (Nettle Leaf) on successful black currant growing. Journ. Bath. West and South Co. **5(16)**: 180–182, 1922.

Ann. Rept. Agric. and Hort. Res. Sta. Long Asliton, Bristol, **1923**: 69–72, 1923.

Reversion disease of black currants; means of infection. Ann. Appl. Biol. **12**(2): 199–210, 1925. (Ann. Rpt. Agric. and Hort. Sta. Univ. Bristol **1925**: 66–76, 1925.)

Lehman, S[amuel] G[eorge]

Tobacco Plant Pathology at the North Carolina Sta. North Carolina Agric. Expt. Sta. Ann. Rept. p. 97–100, 1930.

Work in progress on tobacco mosaic.

Le Pelley, Richard, H[enry]

Introductory note on virus diseases of plants in Kenya. Journ. Hist. Soc. **37**: 198–200, 1931.

A popular discussion.

Leroux, L[ucien]

La chloroses des plantes. (Chlorosis of Plants.) Rev. Gen. Sci. Pur. et Appl. **36**·418–420, 1925.

Lesley, J[ames] W[yvill,] & Lesley, M[argaret] [Campbell] M[ann]

The wiry tomato. A recessive mutant form resembling a plant affected with mosaic disease. Journ. Heredity, **19**(8): 337–344, 1928.

The resistance of varieties and new dwarf races of tomato to curly-top (Western yellow blight or yellows.) Hilgardia **6** (2): 27–44, 1931.

The resistance appears to be due to a tendency to escape infection rather than a tolerance to the virus.

Levshin, A. M.

(Occurrence of elytrosomes in the leaves of mosaic diseased sugar beet.) In V. P. Muraviov, Mozaichnye Bolezni Sakharnoi Svekly (Mosaic diseases of sugar beet.) Kiev. S.S.U. Souizsakhara p. 177–178, 1930. (English Abstract p. 178.)

The author's observations and studies confirm those by Schaffnit and Wever in regard to the occurrence of small bodies in mosaic-diseased sugar beets. He describes those bodies.

Lewin, C. J.

On the incidence of leaf curl of cotton in South Nigeria. Nigeria Dept. Agric. Ann. Bull. **6**: 70–77, 1927.

A history of the disease up to this time and the results of experimental work.

Lewton, Brain L.

Disease resisting varieties of plants. West Indian Bull. **4**(1): 48–57, 1903.

Likhité, V. N.

(The nature and relations of the intracellular inclusions present in the mosaic of tobacco) Medeel Landbouwhoogesch Wageningen **33**(1) 3–25, 1929

Cytological aspects of the virus diseases in plants Mededeel Landbouwhoogesch Wageningen **33**(2) 1–12, 1929.

Lind, J[ens]

Studien uber die sogenannte Panashure und uber einge begleitende Erscheinungen Landw Jahrb **36** 807–862, 1907.

Runkelroernes mosaiksyge (Mosaic disease in beets) Tidsskrift for Planteave **22** 444–457, 1915 (Int Rev of Sci and Pract of Agric **7**(5) 747 1916)

————————, & **Rostrup, Sofie**

Maanedlige oversigter over sygdomme has Landbrugets Kulturplanter fra staten plantepatologistke Forsog, 1916

Lindemuth, H[ugo]

Versammlung des Vereines zur Beforderung des Gatenbance am 1897 Gartenflora **46** 537 598, 1897

Ueber verschiedene Arten den Panaschure, deren Uebertragbarkeit durch Transplantation und Samenbestandigkeit. Gartenflora **54** 125–128, 1905

Studies uber die sogenannte Panaschure und uber einige begleitende Erscheinungen Landw Jahrb **36** 807–862, 1907.

Linford, M[aurice] B[lood]

Pineapple yellow spot transmissible by thrips Pineapple News **4** 43–51, 1930

Evidence showing that the disease is transmitted by thrips

Yellow-spot disease of pineapple transmitted by *Thrips tabaci* Lind Science n s. **73**(1888): 263, 1931 (Hawaii Pineapple Canners' Stat 1 53–61, 1931)

Thrips tabaci has been found responsible for the transmission of yellow spot disease of pineapple in Hawaii

Further studies of transmission of the pineapple yellow-spot virus by *Thrips tabaci* Phytopathology (Abstract) **21**(10): 999, 1931.

The transmission of yellow-spot by *Thrips tabaci.* Pineapple Quart. **1**(2) : 53–62, 1931.

A record of the experimental work. The disease occurred also on *Emilia saggittata.*

Streak a virus disease of peas transmitted by *Thrips tabaci.* Phytopathology (Abstract) **21**(10) : 999, 1931.

A streak disease of common peas (*Pisum sativum*) observed in 1928. *Thrips tabaci* transferred to peas from *Emilia sagittata* (*E. flammea*) developed the streak. *T. tabaci* transferred from peas to peas and to pineapple caused streak and yellow-spot. Streak of peas appears to be the same as yellow-spot of pineapple.

------------ Transmission of pineapple yellow-spot virus by *Thrips tabaci.* Phytopathology **22**(4) : 301–324, 1932.

Detailed report of the writer's observations on the transmission of the pineapple yellow-spot virus by *Thrips tabaci.* The author also considers the relation of the insect vectors with other plant hosts, e. g. *Senecio hieracifolia, Bidens pilosa* and *Sonchus oleraceus.*

Linhart, G[yorgy] & Mezey, G[yula]

A Dohany Mozaikfetegsege. Kulonleny omat á Mezögardesagi szemle. Bol. **1890** : 1–10, 1890.

Die Californisch rübenkrankheit. (The Californian sugar beet disease.) Oesterr. Ungar. Ztschr. Zuickerindus. u. Landw. **30** : 26–42, 1901.

Link, Adeline Mae De Sale

Mosaic and leafroll of the potato in the northwest. Phytopathology (Abstract) **13**(1) : 39, 1923.

Link, G[eorge] K[onrad] K[arl,] Jones, Philip M. & Taliaferro, W[illiam] H[ay]

Possible etiological role of *Plasmodiophora tabaci* in tabacco mosaic. Bot. Gaz. **82**(4) : 403–414, 1926.

The results of experiments with this organism indicate that it is more abundant in diseased than in healthy plants.

Lipschutz, B[enjamin]

Ueber Mikroskopisch sichtbare, filtrierbare Virusarten. Ueber Strongyloplasmen. Centbl. Bakt. Abt. 1, Orig. **48** : 77–90, 1908.

Die mikroskopich Darstellung des filtriebaren Virus (Chlamy-dozoa-Strongyloplasmen.) Kraus, R. und Uhlenhuth, P., Handbuch der mikrobiologischen Technik. **1**: 381–412, 1923.

Liro, J. I[var]

Ueber die mosaikkrankheit der *Prunella vulgaris* L. Ann. Soc. Zool-Bot. Fennicae Vanamo, **11**: 143–149, 1930.

Ledewijks, J[ohan] A[nthon] Jr.

Zur Mosaikkrankheit des Tabaks. (Mosaic disease of tobacco.) Trav. Bot. Neerlandais **7**: 107–129, 1910. (Bot. Centralbl. (Abstract) **114**: 518, 1911. Centralbl. f. Bakt. **31**: 324, 1910.)

Loew, [Carl Benedict] Oscar

Phytological studies of Connecticut leaf tobacco. U. S. D. A. Division of Veg. Phys. and Pathology. Rpt. **65**: 24–27, 1900.

Describes tobacco mosaic and gives results of enzyme studies. Also results of experiments with fertilizer and seed bed treatments.

Lojkin, Mary & Vinson, Carl G[eorge]

Effects of enzymes upon the infectivity of the virus of tobacco mosaic. Boyce Thompson Inst. Contr. **3**(2): 147–162, 1931.

The effects of pepsin, yeast extract, trypsin, papain and erepsin under experimental conditions is given. Boiling destroyed the capacity of the enzyme solution to reduce infectivity of the virus preparations.

Catalase-A new enzyme of general occurrence. U. S. D. A. Div. of Veg. Phys. and Pathology Rpt. **68**: 1–47, 1901.

López Domínguez, F[rancisco] A[ntonio]

Has yellow stripe or mottling disease any effect on the sugar content of cane juice? Journ. Dept. Agric. Porto Rico **3**(4): 47–64, 1919.

Analitical studies which indicate that the disease does not affect materially the sugar content of the juices unless the stalk is drying.

Chemical variations in yellow striped cane. Insular Expt. Sta. Porto Rico. Ann. Rpt. **1920**: 77–78, 1920.

La caña Uba y su rendimiento de azúcar en Puerto Rico. (Yield of the Uba cane in Porto Rico.) Ins. Exp. Sta. Porto Rico. Bull. **28**, 1923. English & Spanish Eds.

The author points out the importance of this variety to save the sugar-cane industry from the mosaic epidemic.

El matizado o mosaico de la Caña: Sus síntomas sobresalientes. (Sugar Cane mosaic: Outstanding symptoms.) La Vida Agrícola, Lima, Perú. 4(46): 803–806, 1927.

Mosaico de la caña de azúcar. Inform. & Mem. Soc. Ingen. Perú **10**(30): 445–455, **11**: 466–478, 1928.

Popular.

El matizado de la caña. Método para su represión. (Sugar cane mosaic, methods for its control.) La Vida Agrícola, Lima, Perú, **5**(50): 89–98, 1928.

El mosaico de la caña de azúcar. (Sugar cane mosaic.) Est. Expt. Agric. de la Soc. Nac. Agraria de Perú, Circ. No. **10**, 23 p., 1928.

Conference before the Engineers' Society of Perú. The author describes the disease and reviews the work done to eradicate it. He advises the planting of immune or resistant varieties.

Loree, R[obert] F[arls,] & Bennett, C[arlyle] W[ilson]

The raspberry situation in Michigan. Michigan Agric. Expt. Sta. Quart. Bull. **5**(1): 31–33, 1922.

Brief popular account of the situation, among other considerations gives roguing as a measure to control mosaic and other diseases.

Loughnane, James B.

Insect transmission of virus A. of potatoes. Nature **131**(3319): 838–839, 1933.

Study of transmission of potato virus A at the Alberta Agricultural College, Dublin. The author concludes that *Myzus persicae* is an efficient vector of virus A from potato to potato and tobacco. Virus A may also be transmissible by *M. circumflexus*, but attempts to cause infection by means of *M. solani*, *Lygus pabulinus*, and *Calocoris bipunctatus* gave negative results.

Ludewig, K[arl]

Beitrage zum Studium der Blattrollkrankheit der Kartoffel. (Contribution to the study of leafroll of potatoes.) Landw. Jahrb. **63**(2): 277–303, 1926.

Results of experiments on starch transfer as in Hiltner's experiments gave negative results.

Ludtke, M.

Utersuchungen uber Viruskrankheiten. Beitrage zur kenntnuis des Stoffwechsees mosaikkranker und gesunder Tabakpflan-

zen. (Investigations about mosaic disease. Contribution on the study of assimilation in mosaic diseased and sound tobacco plant. Phytopath. Ztschr. **2**(4) : 341–359, 1930.

The increase of starch in the mosaic plants does not depend on the decreased efficiency of diastase.

Lushington, P. M.

Spike disease in sandal. An interesting isolated area and its treatment. Indian Forester **44**: 114–117, 1918.

Brief report of the procedures.

Progress of spike investigation in the southern circle, Madras Presidency, during 1917-18. Indian forester **44**: 439–460, 1918.

The author summarized his previous work (Indian Forester 44: 114) and Venkatarama Ayyar (Indian Forester 44: 316) stating additions.

Lyman, G[eorge] R[ichard] et al

Report of the conference on diseases of potatoes and seed certification Washington: War Emergency Bd. Amer. Plant. Path. **1918**: 1–20, 1918.

Lyon, H[arold] L[oyd]

A new cane disease now epidemic in Fiji. Hawaii Planters' Rec. **3**(4) : 200–205, 1910.

Losses due to yellow stripe disease. Hawaiian Planters' Rec. **6**(5) : 258–263, 1912.

Lahaina cane injured by yellow striping. Hawaii Planters' Rec. **10**(5) : 320–321, 1914.

Fiji disease in New Guinea. Hawaiian Planters' Rec. **12**: 200, 1915.

Three major diseases, mosaic, Sereh and Fiji disease. Hawaiian S. P. A. Expt. Sta. Bot. ser. Bull. **3**(1) : 1–43, 1921. (Agric. News. **21**(517) : 62; 78–79, 1922. Rev. Appl. Mycol. **1**: 184–186, 1922.)

A very thorough study of the symptoms and methods of control. Also a study of the causal agent of Fiji.

Cane Pathology. Hawaii S. P. A. Expt. Sta. Rpt. Comm. in charge **1923**: 18–22, 1923. (Rev. Appl. Mycol. **3**: 482, 483, 1924.)

Mac Callum W[illiam] G[eorge]

Present knowledge of filterable viruses. Medicine **5**: 59–78, 1926.

Mac Clement, D., & Smith, J[ohn] Henderson

Filtration of plant viruses. Nature **130**(3273): 129–130, 1932.

Used collodion membranes but found it desirable to standardize every membrane individually. The membranes become clogged with plant materials. However, the authors were able to come to some conclusions concerning the sizes of the particles in several viruses.

Mackenzie, D[onald]; Salmon, E[rnest] S[tanley]; Ware, William M[elvill]e, & Williams, R. D.

The mosaic disease of the hop; grafting experiments, II. Ann. Appl. Biol. **16**(3): 359–381, 1929. (Rev. Appl. Mycol. **9**(2): 131, 1930.)

This paper is a record of grafting with a number of varieties.

Mackie, W[illiam] W[ylie], & Esau, Katherine

A preliminary report on resistance to curly top of sugar beets in bean hybrids and varieties. Phytopathology (Abstract) **21**(10): 997, 1931.

A preliminary report on resistance to curly top of sugar beet in bean. Phytopathology **22**(3): 207–216, 1932.

A more detailed, expanded and fully tabulated account of the writer's previous work in California on varietal resistance to curly-top of sugar beet among beans (*Phaseolus vulgaris*).

Mac Lennan, A[rchibald[H[enderson,] & Presant, F[rederick] W

Tomato mosaic. Ontario Dept. Agric. Bull. **308**: 25–26, 1924.

Popular notes very brief.

Mac Leod, D. J.

Control of mosaic, leafroll and spindle tuber diseases of the potato. Dominion Expt. Farms. Seasonal Hints, East & B. C. Ed. No. **41**, 1928.

Effect of size of seed used in commercial planting on the occurrence of virus diseases in potatoes. Dominion Expt. Farms Seasons Hints, **51**: 9–10, 1931.

A brief paper giving results.

Aster wilt and aster yellows investigations in disease resistance. Canada Dept. Agric. Div. Bot. Rpt. Dom. Botanist, **1930**: 22–23, 1931.

MacMillan, H[oward] G[ove]

Potato mosaic masking at high altitudes. Phytopathology (Abstract) **13**(1) : 39, 1923.

Macoun, W[illiam] T[yrrell]

The potato in Canada. Canada Dept. Agric. Bull. **90**, 100 p., 1918.

Magee, C[harles] J. P[atrick]

Investigations on the bunchy top disease of banana. Australian Council Sci. & Indus. Res. Bull. **30**(1) : 7–64, 1927.

A history of the disease in Australia, its geographical distribution and a description of the symptoms.

Virus or degeneration diseases of potatoes. Agric. Gaz. New South Wales. **41**(6) : 405–412, 1930.

These diseases are prevalent and the infection with leafroll is sometimes as high as 75 to 85 per cent. The author gives suggestions for roguing and seed improvement.

A new virus disease of banana. Agric. Gaz. New South Wales **41**(12) : 929, 1930.

In May 1929 there was observed a new disease on banana with all the appearance of a virus disease. Preliminary experiments showed that it may be transmitted by the banana aphid *Pentalonia nigronervosa.*

Virus diseases of potato. Control methods for tableland growers. Agric. Gaz. New South Wales. **42**(11) : 839–841, 1931.

A brief discussion of control.

Magrou, J[oseph]

Virus filtrants et chamydozoaires. (Filterable viruses and Chlamydozoa.) Rév. Path. Vég. et Entomol. Agric. **10** : 41–43, 1923.

The author compares the bodies found by Kunkel in corn and *Hippeastrum,* with bodies by Negri in rabies, by Palm in tobacco and by Guarnieri in small pox. Most authors consider these bodies as desintegration products of the cell.

Maige, L[ouis] A[lbert]

A new disease of beans. Bull. Agric. Algérie et Tunisie **9**(14) : 334, 1903.

Malhotra, R. C.

Biochemical investigation of mosaic in *Solanum tuberosum.* Journ. of Biochem. **13**(3) : 473–487, 1931.

A brief review of the literature followed by the results of chemical studies.

Malpeaux.

Pour éviter la dégénérescense des Pomme de terre; choix preparation et conservation des tubércules de semence. (To avoid the degeneration of potato; selection, preparation and conservation of the seed tubers. La vie Agric. et Ruralle. Déc., 1918.

Mandelson, L. F.

Citrus psorosis control. Queensland Agric. Journ. **40**(6): 504–507, 1933.

Brief popular account of the disease and report of its occurrence in Queensland since 1927. The author describes the Californian method of controlling it. (This is not a paper on virus diseases strictly, but as this disease has been recently considered as caused by a virus, it is of interest to students on virus diseases.)

Mandenburg, E[dmund] C[arl]

Compulsory eradication of little peach and peach yellows. Michigan State Hort. Soc. Ann. Rpt. **57**: 66–70, 1927.

Manns, T[homas] F[ranklin], & Adams, J[ames] F[owler]

Report of the Department of Plant Pathology and Soil Bacteriology. Delaware Agric. Expt. Sta. Bull. **129**: 18–28, 1921.

Report of the Department of Plant Pathology Delaware Agric. Expt. Sta. Bull. **138**:26–33, 1922.

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Department of Plant Pathology and Soil Bacteriology. Delaware Agric. Expt. Sta. Bull. **135**: 25–46, 1924.

Marchal, Emile [Jules Joseph]

La mosaïque du tabac. (Tobacco mosaic.) Revue Mycologique **19**: 13–14, 1897.

Rapport sur les travaux de la Station de Pathologie végétale de Paris in 1922. (Report of the work done by the Plant Pathology Station, in Paris in 1922.) Ann. des Epiphyties **9**(1): 70–72, 1923.

Report on potato mosaic.

Les maladies a virus filtrants en pathologie végétale. (The filterable viruses diseases in vegetable pathology.) Ann. de Gambloux **36**(6): 177–195, 1930.

Report of virus diseases on *Fuchsia, Antirrhinum,* rose and *Hydrastis canadensis.*

Belgium: short account of crop disease conditions in 1930. Internat. Bull. of Plant Protect. **5**(3): 37–38, 1931.

Brief notes on diseases are given among which is mosaic disease of of chicory (*Cichorium intybus*).

Márquez, Severo L.

Fiji disease of sugar cane. Bureau of Agric. Philippine Islands Circ. **174**. (Philippine Agric. Rev. **18**(4): 573–574, 1925.

A brief popular discussion of the disease.

Marre, Eugene.

La dégénérescence de la pomme de terre. Mission d'études en Hollande. (Degeneration of the potato. Commission of studies in Holland.) 52 p. Imprimerie Carrére Rodez, 1921.

An account of a French mission to Holland for information on the subject. Recommendations for the control of these diseases.

Marshall, William

The Rural Economy of Yorkshire **2**: 51–67, 1888. (London. T. Calell.)

Martin, C.

Discussion on ultramicroscopic viruses infesting animals and plants. Proc. Roy. Soc. **B104**: 537–560, 1929.

Martin Jr., G[eorge] Hamilton

Mosaic of Dahlias. Diseases of forest and shade trees, ornamental and miscellaneous plants in the United States in 1922. Plant Disease Bull. Suppl. **29**: 393–461, 1923. (Mimeographed on page 435.)

Report of virus diseases on *Fuchsia, Antirrhinum,* rose and *Hydrastis canadensis.*

Disease of forest and shade trees, ornamental and miscellaneous plants in the United States in 1925. U.S.D.A. Plant Disease Report. Suppl. **50**: 413–478, 1926.

Report of virus on *Bougainvilea spectabilis, Pelargonium, Hibiscus rosa-sinensis, Delphinium, Viola tricolor, Primula, Ambrosia trifida,* and *Asclepias* spp.

Diseases of forest and shade trees, ornamental and miscellaneous plants in the United States in 1926. U.S.D.A. Plant Disease Reporter, Suppl. **55**: 334–393, 1927.

A record of curly-top virus infecting China aster (*Callistephus Chinensis.*

Diseases of forest and shade trees, ornamental and miscellaneous plants in the United States in 1928. Plant Disease Reporter, Suppl. **73**: 366–396. (Mimeographed.) 1929.

Report on Gladiolus 385 and Iris 387 mosaic.

Martins, J[oseph] P[olkinghorne]

The germination of healthy and mosaic-affected cuttings selected from the same stool. Hawaii Planters' Rec. **33**: 143–144, 1929.

Chlorotic streak disease of sugar cane. Hawaii Planters' Rec. **34**: 375–378, 1930.

This paper gives the results of studies demonstrating a new virus disease.

Field control mosaic disease in Hawaii. Proc. 4th congress Internat. Soc. Sugar Cane Tech. Facts About Sugar (Abstract) **27**(8): 365, 1932.

The disease is much less serious than in the past, owing to rigid field selection and the use of resistant varieties.

Pathology H.S.P.A. Proc. Fifth-second Ann. Meeting **1932**: 23–42, 1933.

Account of sugar-cane mosaic and chlorotic streak of *Coix Lachryma-jobi.*

Martin, William H[ope]

"Spindle-tuber", a new potato trouble. Hints to Potato Growers. New Jersey State Potato Assoc. **3**(8); 1922.

Spindle tuber. A disease of potatoes. New Jersey Agric. Expt. Sta. Ann Rpt. **44**: 345–347, 1923.

Marins Ramos, C. S.

O combate do mosaico (The fight against mosaic.) Bol. Agric. Bahia (Brazil) **15**: 29–33, 63–65, 1926.

Novo methodo para cambatir apropagacao de "mosaico na canna de assucar". (New method of fighting the propagation of "mosaic of sugar cane".) Bol. Min. Agric. Ind. e Comm. Brazil **15**: 793–795. (Correio Agric. Soc. Bahiana Agric. **4**: 199–201, 1926.

This paper is based on Alfaro's studies on the migration of the *Aphid maidis* and recommends planting so that the cane can make a maximum growth before the period of migration.

Martyn, E[ldred] B[ridgeman]

Mosaic disease of cane. Agric. Journ. of British Guiana **3**: 112–113, 1929.

Botanical and Mycological Division Annual Report 1929. Agric. Journ. British Guiana **3**(4): 226–233, 1930.

Sugar-cane mosaic has been reported from British Guiana before. In 1929 was found in several fields mostly in the variety D–625. Attempts have been made to control it but 100 per cent infections was present on the third and fourth ratoons.

Marudarajan, D.

Mosaic disease of sugar cane. Journ. Madras Agric. Stud. Union **15**: 49–56, 1927.

Marx, T., & Merkenchlager, F[riedrich]

Zur biologie der kartoffel. 12. Mitteiking. Beobachtungen und untersuchungen über den verlanf des kartoffelabbaues. (On the biology of the potato. Note 12. Observations and Investigation on the course of potato degeneration. Arb. Biol. Reichsanst, fur Land-und Forswirtsch, **19**(5): 413–492, 1932.

The author discuss symptoms and characters not usually mentioned and the results of some chemical studies.

Massee, A. M. et al.

Experiments in the transmission of reversion in black currants. East Malling Res. Stat. Ann. Rpt. II. Suppl. p. 126–150, 1927.

Further observations on the strawberry *Tarsonemid* mite (*Tarsonemus fragariae* Zimm.) East Malling Res. Sta. Ann. Rpt. **1932**: 117–131, 1933.

Account of the possibility that the mite *Tarsonemus fragariae* Zimm. is a vector of the virus disease "Yellow edge" on strawberries.

Massée, G.

Perpetuation of potato disease and potato leaf curl by means of hibernating mycelium, Kew Bull. **1906**, p. 242–245, 1906.

Massey, R. E., & Andrews, F. W.

The leaf-curl disease of cotton in the Sudan. Empire Cotton Growing Rev. **9**(1): 32–45, 1932.

A preliminary paper giving the history, symptoms, transmission and other data concerning this disease.

Mathur, R. N.

Leaf curl of cotton in garden *Zinnias* in North India. Nature **129**(3265): 797, 1932.

Brief account of a virus disease in garden zinnias identical with leaf curl and transmitted by the same vector (*Bemisia gossypiperda.*)

Leaf-curl in *Zinnia elegans* at Dehra Dun. Indian Journ. Agric. Science **3**(1): 89–96, 1933.

Description, symptoms and nature of a disease occurring at Dehra Dun, India. The disease is transmitted by *Bemisia gossypiperda.* This disease is very similar to a cotton disease in Sudan and transmitted by the same vector. Report of results of transmission experiments, fully detailed and tabulated.

Matsumoto, Takashi

Further studies on the legume mosaic. Journ. Plant. Protect. **9**: 517–520, 1922.

Some experiments with azuki bean mosaic. Phytopathology **12**(6): 295–297, 1922.

The author gives a description of the symptoms and the histology of the diseased plants.

(Azuki bean mosaic). Japanese Journal Plant Protect. **9**(1): 13–17, 1922.

This paper gives a description of the disease and the results of histological studies.

Antigenic properties to tobacco mosaic juice. Journ. Soc. of Trop. Agric. **1**(3): 291–300, 1930.

The author gives the results of experiments which will be summarized as follows: "As stated in the foregoing tables the tobacco mosaic juice was capable of stimulating the production of specific precipitating antibodies when the former was injected into a rabbit. This antiserum was also able to inhibit the infective action of the virus under the circumstances as mentioned above. The infective principle of the virus was precipitated by an specific action of the antiserum, consequently the supernatant liquids were left sterile, but in the normal serum-virus mixture the infective principle was not appreciably affected nor separated by the serum. It is by no means clear, however, whether this precipitating reaction is due to the specific action of the infective principle of the virus or rather may be referable to an interaction of some concomitant antigens which are associated with the infected principle of the tobacco mosaic virus and inseparable from the infective principle by means of ultrafiltration or treatment with alcohol."

---------, & **Somazawa, Koetsu.**

Immunological studies of mosaic disease and heat in activation on the antigenic properties of tobacco mosaic juice. Part I., & Part II. Journ. Soc. of Trop. Agric. **2**(3) : 223–234, **3**(1) : 24–33, 1930.

The authors continue their studies on the antigenic properties of tobacco mosaic juice.

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Immunological studies of mosaic disease. II. Distribution of antigenic substances of tobacco mosaic in different parts of host plants. The Phytopathological Lab., Taihoku Imp. Univ. Formosa, Japan. Contr. 4(2) : 161–168, 1932.

It has been demonstrated that when leaf extracts of mosaic tobacco are injected into rabbit, it is capable of causing a specific precipitate of antibodies. The author gives the inference that the antigenic reaction is actually due to the infective agent.

Immunological studies of mosaic diseases. III. Further studies on the distribution of antigenic substances of tobacco mosaic in different parts of host plants. Journ. Soc. Trop. Agric. **5**(1) : 37–43, 1933.

The authors state that "the presence of the antigenic substance, probably an infective principle itself, is definitely demonstrated in the xylem portion of any infected tobacco plants. It was also confirmed that the virus principle was capable of entering the xylem portion even through an unbroken wall, probably through pits in the walls. With regard to the pathway normally taken by the virus in the living plants however, no definite conclusion can be given at present."

Mattei, G[iovanni] E[ttore]

La variegatura della foglie é douta a batterii? (Is variegation of the leaves due to bacteria? Riv. Biologica **8** : 41–61, 1926.

A summary of work showing that mosaic of plants is caused by bacteria.

Matthews, W. H.

The agricultural progress of the Pomoroon between the years 1905–1917. British Guiana Journ. Agric. **12**(1) : 6–10, 1919.

A brief report.

Matz, Julius

Infection and nature of the yellow stripe diseases of cane. Journ. Dept. Agric. Porto Rico. **3**(4) : 65–82, 1919.

Results of experiments and histological studies. The author describes a granular plasma in some of the cells which he believes may be a cause of the disease.

Ultimos desarrollos en la patología de la caña de azúcar. (Last development in the pathology of sugar cane.) Insular Expt. Sta. Puerto Rico, Circ. **33**: 32–36, 1920.

Paper read before the Sugar-Cane Technologists' Association of Puerto Rico. Reviews the work done in sugar-cane pathology and devoted special attention to mosaic disease.

Naturaleza del mosaico de la caña. (Nature of the mosaic disease of sugar cane.) Sugar **25**: 222–223, 1923.

A discussion of bodies found in mosaic plants.

Annual Report for the Division of Plant Pathology and Botany for the year 1920–21. Insular Experiment Sta. Porto Rico Ann. Report **1920–21**: 52–53, 1921.

Recent development in the study of the nature of mosaic diseases of sugar cane and other plants. Journ. Dept. Agric. Porto Rico **6**(3): 22–27, 1923.

The author reviews the work of Iwanoski, Kunkel and Palm on the intracellular bodies.

Recientes investigaciones en el estudio de la naturaleza del mosaico de la caña de azúcar y otras plantas. (Recent investigations on the studies of the nature of mosaic disease of sugar cane and other plants.) Rev. Agric. Puerto Rico. **9**(4): 9–12, 1922.

Popular discussion of an article that appeared in Journ. Dept. Agric. Puerto Rico. 6(3): 22–27, 1923.

Artificial Transmission of sugar cane mosaic. Journ. Agric. Res. **46**(9): 821–839, 1933.

The author gives a review of the subject and describes a new and successful method of inoculation. A drop of juice from a diseased plant was placed at the base of the youngest leaf of a young plant. A fine needle was passed horizontally or downward through the juice into the tissues five or six times. The juice could be kept at 4 degrees C. indefinitely without inactivation.

Relative infectivity of mosaic virus extracted from various parts of sugarcane. Phytopathology (Abstract) **24**(1): 14–15, 1934.

Maublanc, A[ndré]

La mosaïque de la canne á sucre. (Sugar Cane mosaic.) Agron. Colon. No. **61,** 7 pp. Paris. (Rev. Appl. Ent. Ser. A. **11**: 168.) 1923.

A discussion of the disease with special reference to its transmission by insects.

Maupas, Albert

Sur la maladie de l' enroulement des feuilles de tomates. (Leaf-roll disease of tomatoes.) Rev. Hort. **94**: 52–54, 1922.

A popular discussion.

May, D[avid] W[illiam]

Kavangire in Porto Rico. (A reply to E. W. Brandes.) Facts About Sugar **21**: 522, 1926.

Controversial.

Kavangire in Porto Rico. (A reply to F. S. Earle.) Facts About Sugar, **21**: 1096, 1926.

Controversial.

May, W.

Die Rohrzucker-Culturen auf Java und ihre Sefährdung durch die Serehkrankheit. Bot. Zeitung **49**: 10–15, 1891.

Mayer, A[dolf] E[dward]

Over de mosaikziekte van de tabak: (On the mosaic disease of tobacco) Woorloopige Meded. Landbouwk. Tijdschr. **1882**: 359–364, 1882.

Over de in Nederland dikwijls voorkomende Mozaikziete der Tabak. (The occurrence of tobacco mosaic disease in Holland.) Landb. Tydschrift. **31,** 1885.

Ueber die Mosaikkrankheit des Tabaks. (Tobacco mosaic disease) Landw. Versuchs. Stat. **32**: 450–467, 1886. (Journ. Mycology (Abstract) **7**: 382–385, 1894.)

The first important paper on tobacco mosaic. Believed the disease to be caused by bacteria but failed to isolate an organism that would reproduce the disease. Disease not caused by fertilizers and not carried by the seed.

Ueber die mosaikkranheit des tabaks. Landw. Vers. Sta. 451–467, 1886.

Heilung der Mosaikrakheit des tabaks. (Curing of tobacco mosaic disease.) Landwirsch. Versuch. **35**:339–340, 1888.

Ueber die Mosaikkrankheit des Tabaks. (Mosaic disease of tobacco.) Journ. of Mycology **7**(4): 382–385, 1894.

An extensive abstract in English by Erwin F. Smith of the paper which appeared in Landw. Versuchs. Stat. **32**: 450–457, 1886.

Blattrollkrankheit der Kartoffel. (The leafroll disease of potato.) Fuhlings Landw. Zeitg. H. **19–20**: 474–478, 1916.

Mc Alpine, D.

Bitter pit investigations. First Progress Rpt. 197 p., 1911–12; Second Progress Rpt. 224 p. 1912–13; Third Progress Rpt. 176 p., 1913–14; Fourth Progress Rpt. 187 p., 1914–15; Fifth Progress Rpt. 144 p., 1915–16.

Bitter pit in apples and pears: the latest results in preventive measures. Phytopathology **11**(9): 366–370, 1921.

Account of this disease and preventing measures with special reference to breeding measures. (Written before the cause of the disease was known.)

McCall, T[homas] M[ontgomery]

The effects of certain cultural practices on the transmission of virus diseases of the potato. Potato Assn. of Amer. Ann. Meeting 16th Proc. **1929–30**: 161–163, 1930. (Rev. Appl. Mycol. **9**: 551, 1930.)

In northern Minnesota spindle tuber gave losses as high as 40 per cent. Other virus diseases less. Gross work on transmission of spindle tuber by cutting knives is confirmed.

Mc Callan, E[rnest] A[lbert]

Report of seed potato inspection. Bermuda Agric. Dept., Agric. Bull. **1922**: 4–7, 1922.

A record of the amount of leafroll and mosaic in plants grown from the same stock in Bermuda and Nova Scotia.

Bermuda: Eine Krankheit der *Lilium longiflorum* und die "Aster yellows". (Bermuda: A disease of *Lilium longiflorum* and the aster yellows.) Inst. Anz. Pflanzenschutz. **1**: 65, 1927.

Mosaic disease of sugar cane with special reference to its eradication in Natal. South African Sugar Journ. **12**(8): 483–489, 1928.

Sugar cane diseases in South Africa South African Sugar Journ **13**(9) 573, 575, 577, 579, 1929, **14**(6) 399–407, 1930. (Rev Appl Mycol **9**(3) 202–203, 1930)

Mosaic and streak diseases are the most important and are described. Resistant varieties are recommended as means of control.

Mc Clean, A[lan] P[ercy] D[ouglas]

The mosaic campaign Latest information regarding the position South African Sugar Journ **11**(5) 297–298, 1927. (Rev Appl Mycol **6** 696 1927)

The status of the campaign at date of publications

Bunchy top disease of the tomato Dept Agric South Africa, Sci Bull **100**, 28 p, 1931

An extensive description of this disease on tomato and its behavior No insect vectors have been demonstrated in the author's tests It is readily transmitted artificially and by grafting It failed to be transmitted to tobacco but it was successfully transferred to *Physalis peruviana* and back to tomato Control measures are recommended

Bunchy top disease of the tomato Farming in South Africa **6**(67) 275–276 280, 1931

Popular account describing the disease The author states that tomato bunchy top virus is similar to that of tobacco mosaic Explains ways of spreading and gives control measures

Control of mosaic disease in South Africa Proc Fourth Intern Congr Sugar Cane Technologists 1932 (Facts About Sugar (Abstract) **27**(6) 260, 1932)

It was found practically impossible to eradicate mosaic disease from sugar cane, due to the occurrence of the disease on the grass *Setaria Sulcata* which is widely distributed in South Africa The author declares that it has been reduced to a minimum by the planting of immune or highly resistant varieties (P O J 2878, 2727, 2725 and 2714, Co 290, and C H 64/21)

Streak disease of sugar cane South Africa Sugar Journ **17** (5) 247, 249, 251, 253, 255, 257, 259, 1933

Paper read before the South African Sugar Technologists' Annual Congress The author makes a full account of the present conditions of the disease in South Africa

The behaviour of the cane variety P O J 213 towards streak disease Fourth Congress Intern Soc Sugar Cane Technologists, Puerto Rico 1932, Bull **27**, 6 p, 1933

Studies on the behaviour of streak disease in the P. O. J. 213 sugar-cane variety.

Mc Clintock, J[ames] A[lbertine]

Is cucumber mosaic carried by seed? Science n.s. **44**(1144): 786–787, 1916.

Gives evidence that the disease is carried in the seeds.

Peanut mosaic: an investigation of plant disease. Peanut Promoter **1**: 29, 1917.

Peanut mosaic. Science n.s. **45**: 47–48, 1917. (Int. Rev. Sci. & Pract. Agric. **8**(5): 802–803, 1917.)

A brief paper, gives a record of the disease.

Lima bean mosaic. Phytopathology (Abstract) **7**(1): 60–61, 1917.

Spinach blight. Phytopathology (Abstract) **8**(1): 74, 1918.

———, & **Smith L[oren] B[arlett]**

True nature of spinach blight and relation of insects to its transmission. Journ. Agric. Res. **14**(1) 1–59, 1918.

Gives a description and history of the disease and the results of experiments with fertilizers, and methods of transmission. Demonstrated that the disease was infectious and carried by *Macrosiphum solanifolii*.

Overwintering of mosaic of annuals. Phytopathology (Abstract) **11**(1): 47, 1921.

Peach rosette, an infectious mosaic. Jour. Agric. Res. **24**(4): 307–316, 1923.

Gives the results of experimental budding which proves that the disease can be transmitted in this manner.

Cross-inoculation experiments with *Erigeron* yellows and peach rosette. Phytopathology **21**(4): 373–386, 1931.

Cross-inoculation of aster yellows, peach rosette were made and observed. Several insects were observed as to the capability to transmit those diseases.

Mc Cubbin, W[alter] A[lex]

Report from the branch laboratory of the Division of Botany. Canada Expt. Farms. Rpts. **1913**: 497–498, 1913.

The disease of tomatoes. Canada Agric. Expt. Farms. Bull. **35**: 16 p., 1918.

Peach yellows and little peach. Pennsylvania Dept. Agric. Gen. Bull. **382**, 16 p., 1924.
A popular discussion of the subject.

Present status of peach yellows in Pennsylvania. Pennsylvania State Hort. Soc. Proc. **66**: 75–78, 1925.

Three little known diseases of peach. Pennsylvania State Hort. Soc. Proc. **67**: 46–50, 1926.

Peach yellows and little peach. Pennsylvania Dept. Agric. Bull. **10**(3): 3–16, 1927.

---------, & **Holdridge, F. L.**
Observations on peach yellows Pennsylvania Acad. Sci. **1**:, 1927.

Some comments on the virus diseases. Hints to Potato Growers, 1927.
Popular notes.

Peach yellows report 1927. Pensylvania Dept. Agric. Bull. **11**(6): 3–25, 1928.
This paper gives the results of inspection and eradication work. Also a discussion of various phases of the problem.

---------, & **Smith F[loyd] F[ranklin]**
Rate of virus spread in tomato plant. Science n.s. **66**(1716): 486–487, 1927.
A short paper giving the results of experiments which indicate that the virus travels through tomato shoots at the rate of from one to two inches per day.

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Spread of mosaic virus in tomato plants. Phytopathology (Abstract) **20**(1): 134, 1930.

Spread of mosaic virus in tomato plants. Journ. Bact. **19**(1): 23, 1930. (Rev. Appl. Mycol. **9**: 416, 1930.)
The virus travels from one to two mm. per hour but the rate varies with the temperature.

Report on peach yellows inspection in Pennsylvania in 1929. Plant Disease Reporter **14**(4): 33–37, 1930.

Mc Donald, J[ohn]

Annual Report of the Mycologist for the year 1922. Kenya Dept. Agric. Ann. Rpt. **1922**: 111–115, 1924.

Report of the Mycologist for the period April 1st. to Dec. 31, 1921. Kenya Dept. Agric. Ann. Rpt. **1921**: 123–126, 1925.

Annual Report of the Mycologist for 1928. Kenya Dept. Agric. Ann. Rpt. 1928. (Rev. Appl. Mycol. **8**: 632–633, 1929.)

Contains a reference to the mosaic of sugar cane in one district.

Mc Kay M[arion] B[ertice]

Mosaic disease of tomatoes. Oregon Agric. Expt. Sta. Crop. Pest & Hort. Rpt. **3**(1915–1920): 179–184, 1921.

A popular description.

Potato diseases in Oregon and their control. Oregon Agric. Expt. Sta. Circ. **24**: 47–51, 1922.

Brief popular notes on mosaic, curly dwarf, leaf roll, spindle sprout, and net necrosis.

----------, **& Dykstra, Theodore P[eter]**

Curly top of squash. Phytopathology (Abstract) **17**(1): 48–49, 1927.

Sugar beet curly top virus, the cause of the western yellow tomato blight. Phytopathology (Abstract) **17**(1): 39, 1927.

Narcissus and tulip diseases. Oregon State Hort. Soc. Ann. Rpt. **18**: 137–150, 321–323, 1926.

----------, **Brierley, Philip, & Dykstra, Theodore P[eter]**

Tulip "breaking" is proved to be caused by mosaic infection. U. S. D. A. Yearbook **1928**: 596–597, 1929.

Brief account on this disorder known as "breaking". Description of methods of inoculation and discussion of insect vectors.

Potato virus diseases: Oregon investigation 1924–1929. Oregon Agric. Expt. Sta. Bull. **294**: 40 p., 1932.

----------, **& Dykstra, Theodore P[eter]**

This paper gives results of experimental work for six years. *Myzus persicae* transmits crinkle, rugose, leaf-rolling mosaic and leaf roll but

not mild mosaic; *Illinoia solanifolii* (*Macrosiphum gei*) transmits leaf-rolling mosaic and leaf roll but was not as efficient as some other carriers. It did not transmit mild mosaic, rugose mosaic or crinkle; *Myzus (Macrosiphum) pelargonii* transmitted leaf-rolling mosaic and leaf roll but did not transmit mild mosaic, crinkle or rugose mosaic. *M circumflexus* transmitted crinkle, rugose, mosaic and mild mosaic from diseased to healthy potato under insect proof cages without insects

————————, & **Warner, M. F.**

Historical Sketch of Tulip Mosaic or Breaking, The Oldest Known Plant Virus Disease The Nat Hort **12**(3) · 179–216, 1933

A history of this disease and reproductions of old drawings This is the oldest virus disease of which we have any record The paper also includes a description of the disease and a very complete bibliography dating back to 1561

————————, **Dykstra, T. P., Morris, H. E., Young, P. A. Richards. B. L, & Blood, H. L.**

Virus and virus-like diseases of the potato in the northwest and their control U S D A Circ **271,** 31 p., 1933

The potato virus diseases studied include mild, crinkle, and rugose mosaic, leaf roll, witches broom and spindle tuber Descriptions of them are given and methods of control Other disorders studied which appears to belong to the virus disease group were calico, psyllid yellow and giant hill Tuber indexing is recommended as the ideal method for eliminating the virus diseases from the seed stock, roguing is also advisable.

McKenny Hughes, A. W.

Aphis as a possible vector of "breaking" in tulip species Ann. Appl. Biol. **17**(1) · 36–42, 1930.

The author suggests *Myzus persicae* Sulz. as a vector of the virus that produces "breaking" in tulips, also associated with "red-streak break" *Macrosiphum gei* Kock possibly carries "break" in a lesser degree and is associated with "white streak"

Aphides as vectors of "Breaking" in tulips Ann Appl Biol **18**(1) 16–29, 1931.

Experiments are described *Myzus persicae* is responsible for the transmission of the disease and *Macrosiphum gei* to a lesser extent. Two types of "breaking" were distinguished

Aphids as vectors of "breaking" in tulips II. Ann. Appl. Biol. **21**(1): 112–119, 1934.

The author distinguishes three types of "breaking" e. g. full, self and clotted. Two viruses produced full breaking. Self breaking may be selectively transmitted by the aphis vectors *Myzus persicae* Sulz.

and *Macrosiphum gei* Kock. Self-breaking tulips only transmit self-breaking. At a certain stage of growth tulips cease to be susceptible to infection.

Mc Kinley, Earl Baldwin

Filterable virus diseases of plants. Philippine Journ. Sci. **39** (1–4): 344–367, 1929.

Chapter XIV of this work is devoted to "Filterable Virus Diseases of Plants", which is a very comprehensive review of the subject.

A concept of the ultramicroscopic virus diseases and a classification. Science. n.s. **76** (1977): 449–454, 1932.

A general discussion on virus diseases trying to define and classify them. Although it is not a paper on plant virus disease, it is of interest to students on the subject.

Mc Kinney, H[arold] H[all,] & Larrimer Walter H[arrison]

Symptoms of wheat rosette compared with those produced by certain insects. U.S.D.A. Bull. **1137,** 8 p., 1923.

Comparative descriptions.

-------------, Eckerson, Sophia H[emison,] & Webb, Robert W[illiam]

The intracellular bodies associated with the rosette disease and a mosaic-like leaf mottling of wheat. Journ. Agric. Res. **26** (12): 605–608, 1923. (Phytopathology (Abstract) **13** (1): 41, 1923.)

The authors describe the intracellular bodies and discuss their possible nature.

Intracellular bodies associated with a mosaic of *Hippeastrum Johnsonii*. Phytopathology (Abstract) **13** (1): 41–42, 1923.

Investigations of the rosette disease of wheat and its control. Journ. Agric. Res. **23** (10): 771–810, 1923.

A description of the disease. The cause is unknown but the disease can be transmitted by the soil. The active agent is destroyed by soil sterilization.

Certain aspects of the virus diseases. Phytopathology **15** (4): 189–202, 1925.

A comparison of characters of the virus diseases of animals and plants.

A mosaic disease of winter wheat and winter rye. Phytopathology 15(8): 495–496, 1925. (U.S.D.A. Bull. 1361, 10 p., 1925.)

A brief note in which the author states that this disease is not carried in the seed. It is found in the soil.

-----------, **Webb, Robert W[illiam,] & Dungan, G[eorge] H[arlan]**

Wheat rosette and its control. Illinois Agric. Expt. Station Bull. 264: 275–296, 1925.

A description of the disease including some cytology. Also studies to determine cause and control.

Factors affecting the properties of virus. Phytopathology 16 (10): 753, 1926.

Virus of a high concentration has a higher thermal death point than a virus of a low concentration. Diluted virus becomes more inactivated at room temperature than undiluted virus.

----------, **Webb, Robert W[illiam]**

The dilution as a means for making certain quantitative studies of viruses. Phytopathology (Abstract) 16(1): 66, 1926.

Virus mixtures that may not be detected in young tobacco plants. Phytopathology 16(11): 893, 1926

Brief report on study of common and yellow mosaic.

Factors affecting certain properties of a mosaic virus. Journ. Agric. Res. 35(1): 1–12, 1927.

This paper gives a brief review of the literature and the results of experiments with temperature, mixing with extracts from other plants, dilution, etc.

Quantitative and purification methods in virus studies. Journ. Agric. Res. 35(1): 13–38, 1927.

This paper gives the results of inoculation experiments, purification studies and variability of extracts. "From the results presented it is evident that the methods of culturing and selecting the plant material, and the methods employed in making and manipulating the virus extracts must be standardized just as far as possible to insure reasonably uniform results."

Virus diseases observed by the Allison V. Armour Expedition. Phytopathology (Abstract) 18(1): 155, 1928.

A "Streak" of tomatoes produced by a disturbing principle from apparently healthy potatoes in combination with tomato mosaic. Phytopathology **18**(3): 311, 1928.

Brief note giving his observations.

Further studies on the quantitative virological methods. Science N. S. **68**(1764): 380–392, 1928.

Gives improvements on the methods in use and cautions to insure accuracy. Also brief statements as to the influence of light and temperature.

Centrifuging filterable viruses. Science n.s. **67**(1732): 271, 1928.

Reviews a note by M. S. Marshal (Science n. s. Sept. 2, 1927, page 219) and a paper by himself (Journ. Agric. Res. 35: 13–38, 1927.)

Mosaic diseases in the Canary Islands, West Africa and Gibraltar. Journ. Agric Res. **39**(8): 557–578, 1929. (Rev. Appl. Mycol. **9**: 260, 1930.)

Gives the results of studies on mosaic in the Canary Islands. Also in West Africa.

Differentiation of virus causing green and yellow mosaics of wheat. Science n. s. **73**(1902): 650–651, 1931.

Wheat mosaic can be resolved into two distinct types, yellow and green. The rosette is associated with the green but not the yellow type.

A mosaic of wheat transmissible to all cereal species in the tribe *Hordeæ*. Journ. Agric Res **40**(6): 547–556, 1930.

The author records ten species as susceptible to this disease. Each species contains resistant strains. Rosette was found associated with mosaic and is considered a phase of the disease.

Further studies on virus purification. Phytopathology (Abstract) 21(1): 118, 1931.

Four apparently undescribed mosaics which go to tobacco Phytopathology (Abstract) 21(1): 118, 1931.

Mc Larty, H[arold] R[oss]

Suspected mosaic disease of sweet clover. Phytopathology **10** (11): 501–503, 1920.

A brief note.

Witches' broom of potatoes. Sci. Agric. **6**(11): 395, 1926.

Mc Lean, W.

The control of leaf-roll disease in potatoes by the diagnosis of "Primarily infected" tuber. Journ. Agric. Sci. **16**(1): 149–157, 1926.

Healthy tubers lose weight when dried more rapidly than primarily infected tubers.

Effect of leaf-roll disease in potatoes on the composition of tuber and "mother tuber". Journ. Agric. Sci. **16**(2): 318–324, 1926.

A chemical study of the disease.

Mc Murran, S[tockton] M[osby]

Pecan rosette in relation to soil deficiencies. U. S. D. A. Bull. **756**, 11 pp. 1919.

Mc Murtrey Jr., J[ames] E[dward]

Effect of the mosaic disease on yield and quality of tobacco with suggestions for control. Maryland Agric. Expt. Sta. Bull. **302**: 147–158, 1928.

This paper gives valuable data as indicated in the title.

Effect of mosaic disease on yield of tobacco. Journ. Agric. Res. 38(5): 257–268, 1929.

Very similar to the preceding paper.

Mc Rae, W[illiam]

Report of the Imperial Mycologist. India Agric. Res. Inst. (Pusa) Sci. Rpts. **1921–22**: 44–50, 1922.

Mosaic disease of sugar cane in India in 1925. Agric. Journ India **21**(3): 198–202, 1926. (The Planter & Sugar Manuf. **77**(17): 331–332, 1926. Mundo Azucarero. **14**(5): 152–154, 1926. Rev. Appl. Mycol. **5**: 695–696, 1926.)

Report about the conditions of sugar-cane varieties in regard to mosaic disease and the spread of it in India. Contains also a considerable amount of historical data concerning the disease in India.

Report of the Imperial Mycologist. India Agric. Res. Inst. (Pusa) Sci. Rpts. **1926–27**: 45–55, 1928. (Rev. Appl. Mycol. **7**: 302–304, 1928.)

Contains a statement concerning mosaic on sugar-cane seedlings.

————————, & **Subramanian, L[ekshminarayanapuram] S[ubramania]**

A further note on the mosaic disease of sugar Cane. Agric. Journ. India **23**(4): 239–255, 1928. (Rev. Appl. Mycol. **8**: 63, 1929.)

A description of the disease, its distribution in India and the results of varietal tests.

Effect of mosaic on the tonnage and juice of sugar cane in Pusa, Part II. Indian Journ. Agric. Sci. **2**: 378–384, 1932.

The results of carefully controlled plot experiments. The germination, yield, juice and sucrose was lower in diseased than in healthy cane.

Experiment to test the difference in yield between sugar cane with mosaic disease and free from mosaic disease during the season 1930–31 in Pusa. Fourth Cong. Intern. Soc. Sugar Cane Technologist, Puerto Rico, 1932. Bull. **28**, 4p., 1933.

Account of observations and results of experiments made by the author.

Mc Rostie G[ordon] P[eter]

Inheritance of disease resistance in the common bean. Journ. Amer. Soc. Agron. **13**(1): 15–32, 1921.

Mc Whorter, Frank P[aden]

The nature of the organisms found in Fiji galls of sugar cane. Philippine Agric. **11**(4): 103–111, 1922. (Louisiana Planter **70**: 148–150, 1923. Rev. Path. Veg. & Ent. Agric. **10**: 99, 1923.)

A very careful study of the life history of the organisms which he describes under the name of *Phytamoeba sacchari*.

The mosaic situation. Philippine Agric. **12**(2): 93–95, 1923.

A summary of several papers on mosaic disease.

Cause and control of Fiji disease of sugar cane. Agric. Journ. India. **18**: 651–652, 1923.

A popular paper.

Further report on rose mosaic in Oregon. U. S. D. A Plant Disease Reporter. **15**(1): 1–3, 1931. (Mimeographed).

Description of the disease and wild hosts are given.

Narcissus "gray disease" is a transmissible mosaic. Oregon Agric. Expt. Sta. Dept. Bot. Tech. Paper **180**, 1932. (Florists' Exchange. **79**(14):11, 1932.)

Account of the transmissibility and control of narcissus "gray" or mosaic disease.

----------, **Weiss, Freeman**

Diseases of narcissus. Oregon Agric. Expt. Sta. Bull. **304**, 41 p. 1932.

A brief reference to virus diseases.

Narcissus mosaic symptoms. Phytopathology (Abstract) **22** (12): 998, 1932.

A preliminary analysis of tulip breaking. Phytopathology (Abstract) **22**(12): 998, 1932.

Medalla, M[ariano] G., & Reyes, G[audencio] M.

Fiji disease of sugar cane. Philippine Farmer **7**:3, 5, 1921.

A popular discussion of the subject and recommendations for a domestic quarantine, the use of resistant varieties and disease-free seed.

Fiji disease of sugar cane in the Philippine Islands. Phytopathology **11**(6): 251–252, 1921.

Records of the disease and recommendations for quarantine.

----------, **& Serrano, F[elicísimo] B.**

Losses from mosaic disease. Sugar Cent. & Planters' News **3** (11): 543–544, 1922.

Diseases of sugar cane in the Philippines. Sugar Cent. & Planters' News **4**(8):390–392, 1923.

Popular.

Meer, Jikke H. H. van der.

(A study of the virus from the apparently healthy potato variety. "Green mountain".) Zentral-blatt für Bakteriologie, Parasitenkunde und Infektionskrankheiten, II. Abt. Bd. **87**, 1932.

The author gives the results of extensive experiments which she summarizes in part as follows: "The apparently healthy potato variety 'Green Mountain', is carrier of a virus, that produces different symptoms of disease depending on the host and the stage of development of the leaves." "After inoculations with juice of Green Mountain-tuber or leaves, two varieties of *Capsicum annuum L.* reacted by necro-

s's; *Datura Stramonium L.*, tomato, tobacco and *Hyoscyamus niger L.* by distinct mosaic; *Physalis Alkekengi L.* and *Solanum nodiflorum* Jack. by mild mosaic; whereas *Atropa Belladona L.*, *Solanum Dulcamara L.*, *Solanum Capsicatrum L.*, and *Cyphomandra betacea* Sendt. showed no symptoms at all." The author gives much other interesting and valuable data.

Megaw, W. J.

Notes on experiments related to loss of vigor in stocks of potatoes. Journ. Min. Agric. North Ireland. **1**: 37–45, 1927.

Melchers, L[eo] E[dwards]

The mosaic disease of the tomato and related plants. Ohio Nat. **13**(8): 149–173, 1913. (Contrib. Bot. Lab. Ohio Univ. No. **74**.)

Reviews the work of other students and gives the results of his own studies on histology.

A preliminary report on raspberry curl or yellow. Ohio Nat. **14** (6): 281–288, 1914.

The mosaic or white pickle disease of cucumbers. Kansas State Hort. Soc. Trans. **34**: 102–104, 1918.

A description of the disease in greenhouse. The losses are estimated at 20 per cent.

----------, & Hurley, Fellows.

Wheat mosaic in Kansas, U.S.D.A. Br. Plant Indus. Rpt. **14**: 158, 1930.

Wheat mosaic in Egypt. Science n.s. **73**(1882): 95–96, 1931.

Field observations were made by the author. He believes that rosette of wheat and barley are associated with mosaic. From observations he concluded that the United States virus diseases of wheat are distinct from those in Egypt.

Plant disease problems in Egypt. Trans. Kansas Acad. Sci. **35**: 38–62, 1932.

Brief notes on the progress of the work on the following virus diseases: Wheat mosaic and rosette, mosaic of *Vicia faba* and *Phaseolus vulgaris*, mottled and "fern leaf" forms of mosaic on tomatoes, mosaic on pepper (*Capsicum annuum*), sweet melon and sugar cane, streak on sugar cane and banana bunchy top.

Melhus, Irving E.

Notes on mosaic symptoms of Irish potatoes. Phytopathology (Abstract) **7**(1): 71, 1917.

Mosaic studies. Phytopathology (Abstract) **12**:(1) 42, 1922.

————————, **& Henderson, W. J.**

The yellow dwarf of onions. Phytopathology (Abstract) **19(1)**: 86, 1929.

————————, **Reddy, C[harles] S[teven], Henderson, W. J., & Vestal, Edgar F[red]**

A new virus disease epidemic on onions. Phytopathology **19**(1): 73–77, 1929.

A discussion of this disease, including description, estimate of losses and proof that it is due to a virus.

Mencacci, M.

Le malattie delle degenerazione della patate. (The degeneration diseases of the potato.) Biol. Mens. Inform. Not. Rom. **5** (7–12): 53–59, 1925.

Mendiola, N[emesio] B[lanco], & Unite, Juan O.

Sugar cane breeding in the College of Agriculture. The Philippine Agric. **13**(3): 115–128, 1924.

————————, **& Ocfemia, G[erardo] O[ffimaria]**

The work of breeding resistant crop plants at the College of Agriculture at Los Baños. The Philippine Agric. **15**(3)117–128, 1929. (Rev. Appl. Mycol. **6**: 43, 1926.)

Contains brief statements concerning work for the control of Fiji disease of sugar cane and bunchy top of *Musa textilis.*

Menéndez Ramos, R[afael]

El suelo no puede ser responsable del matizado de la caña. (The soil can not be responsible for the mottling of sugar cane.) Rev. Agric. Puerto Rico. **11**(3): 13–20, 1923.

The soil is not the cause of the disease.

Sigamos con el matizado. (Let us continue with the mottling disease.) Rev. Agric. Puerto Rico. **11**(5): 23–28, 1923.

Sugar cane disease. Ins. Expt. Sta. Puerto Rico Ann. Rpt. **1922–23**: 21–22, 1923.

A brief record.

La cal como enmienda (Lime as an amendment). **Insular Expt.** Station, Porto Rico. Circ. **74**, 17 p., 1923.

Discussion on the agricultural uses of lime. The author discusses the popular belief that lime is a cure of sugar-cane mosaic. He declares that lime is not a cure for the disease.

Estudios sobre el mosaico de la caña. Movimiento del virus a través del tallo en el caso de infecciones secundarias. (Studies on sugar cane mosaic disease. Movement of the virus through the stalk in cases of secondary infections.) Rev. Agric. de Puerto Rico. **13**(4): 219–226, 1924 (Rev. Appl. Mycol. **4**: 244. Louisiana Planter & Sugar Manuf. **73**(25): 488–489, Rev. Agric Com & Trab. Cuba 7(5): 31–33, 1925.)

All the cuttings from a stalk of cane on which only a part of the leaves are mottled, will probably produce diseased plants.

Mosaic disease and methods of control. Planter & Sugar Manuf. **75**(25): 487–498, 1925. (Rev. Appl. Mycol. **5**: 329, 1925.)

A popular discussion of the subject.

La enfermedad mosaico y los métodos de combatirla. (The mosaic disease and methods to control it.) El Mundo Azucarero **13**(8): 241–245, 1926.

A translation of the previous citation. Planter & Sugar Manuf. 75: 487–489. 1925.

The control of sugar cane mosaic in the West Indies. Ref. Book of the Sugar World (The Planter & Sugar Manuf.) **5**: 38–41, 1927.

A short paper giving extensive data on field studies.

El comportamiento de la enfermedad del mosaico en las variedades POJ–2714, 2725, y 2727 en la Provincia de Oriente. (Behavior in regard to the mosaic disease of the sugar cane varieties POJ–2714, 2725, and 2727 in the Province of Oriente.) Suplemento de la Memoria de la Segunda Conferencia Annal Asociación de Técnicos Azucareros de Cuba. Dec. 1928, p. 35–62, 1928. (Planters & Sugar Manuf. 81(6): 101–104, 1928.)

The calculation of mosaic infection in highly resistant canes. Int. Sugar Journal (Abstract) **35**(419): 428, 1933.

Paper presented at the Sixth Annual Conference of the Association of Sugar-Cane Technologists of Cuba, held in December, 1932. The author grouped the varieties according to the behaviour of the disease on each, thus P. O. J. 2725 and Java–Barbados hybrids derived from it in one group and B. H. 10(12), S. C. 12(4) and Cristalina in

another. He establishes the stalk unit as measurement in calculating mosaic infection against the stool unit, which he declares is misleading in determining the relative commercial immunity. He gave a table comparing the results of both unit basis. He states that incidentally, it may be noted that many of the crosses of P. O. J. 2725 and S. C. 12(4) are more resistant than the female parent in spite of the fact that the male parent is very susceptible. Further, the two varieties M 28 and F. C. 916 show a relatively high susceptibility in contrast with a practical immunity recorded in Puerto Rico.

Menezes Sobrino, A.

O mosaic da canna. (The mosaic de cane.) Bol. Agric. Bahia (Brazil) **1926**: 25–28, 1926.

Merkel, L[udwig]

Beiträge zur kenntnis der Mosaikkrankheit der Familie der *Papilonaceae*. (Contribution to the knowledge of the mosaic disease of the family of the *Papilonaceae*.) Zeitschr. für Pflanzenkrankn (Pflanzenpath) u. Pflanzenschutz. **39**(8–9): 289–347, 1929. (Rev. Appl. Mycol. **9**(2): 120–121, 1930.)

This paper contains a great deal of data concerning mosaic of legumes.

Merkenschlager, F[ritz]

Zur Biologie der Kartoffel. II Mitteilung. Zur Pathologie der Blattrollkrankheit. (On the biology of the potato. Note II. On the pathology of the leaf-roll disease.) Arb. Biol. Reichsanst. für Land-und Fortwirtsch. **17**(4): 345–376, 1929. (Rev. Appl. Mycol. **9**(2): 122–123, 1930.)

A discussion of the histology of the diseased plant. Also a study of soil relationships.

Zur Biologie der Kartoffel. (On biology of the potato) 4 Mitt. zur Pathologie des Abbaus. Arbeit. Biol. Reichsanst. **17**: 435–458, 1930.

Kartoffelprobleme. Die Schwarzfärbung des Kartoffelfleisches. Das Abbauproblem. Über die sog. Viruskrankheiten der Kartoffel. Kartoffelban, **14**: 61–63, 73–75, 1930.

---------, & **Klinkowski, M[aximilian]**

Zur Biologie der Kartoffel. VI Mitteilung. Der Rückzug der Kartoffelsorte Magnum Bonum nach Skandinavien in Lichte der okologischen Abbautheorie. (On the biology of the potato. Note VI. The retreat of the potato variety Magnum Borum into Skandinavia in the light of the ecological de-

generation theory.) Arb. Biol. Reichsanst. für Land-und Fortwirtsch. **18**(4): 431–463, 1931.

Comparison of the potato variety in regard to its behaviour in Germany and Scandinavia.

Neue Untersuchngen über die Ursache der Degeneration der Kartoffel. (New investigations on the cause of degeneracy of the potato.) Forschungen u. Fortschritte **8**: 58, 1932.

Merrill, E[lmer] D[rew]

Breeding sugar beets for resistance to curly top. California Agric. Expt. Sta. Ann. Rpt. **1928–29**: 64, 1929. (Rev. Appl. Mycol. **9**: 424, 1930.)

Notes in this report of the work done by the corresponding department.

Meulen, J. G. J. van der

Voorloopig onderzoek near de specialisatie en de infectiebronnen der mosaiekziekten van landbouwgewassen. (Preliminary investigations in the specialization of infection process of mosaic disease of cultivated plants.) Tijdschr. Plantenz. **34**(5): 155–176, 1928. (Inst. Phytopath. Lab. Mycol. en Ardappelonderzoek Meded. **35**: 155–176, 1928. Zeitschr Pflanzenkrankh. **38**: 326–328, 1928.)

This paper gives the results of inoculation experiments.

Meyer, F. H.

Die Kräuselkrankheit der Kartoffel. (The curl disease of the potato.) Ill. Landw. Zeitg. **42**: 295, 1922.

Meyer, H[ans]

Das Chlorose-und Panaschürenphänomen bei Chlorellen. Beih. Bot. Centralbl. **49**: 496–566, 1932.

Milbraith, D[avid] G[allens]

Mosaic diseases of plants. California Cultivator **62**: 541, 1924.

Popular.

Plant Pathology. California Dept. Agric. Monthly Bull. **17** (12): 683–687, 1928. (Rev. Appl. Mycol. **9**(1): 23, 1930.)

Virus diseases of roses are reported.

Infectious chlorosis of the rose. Western Florist **13**(29): 29-30, 1930.

A discussion of the reported infections chlorosis of the rose. California Dept. Agric. Monthly Bull. **19**(8): 535–544, 1930.

No proof of the presence of an infective material has been presented. The author agrees that if the condition is a specific disease then it differs from all other known virus diseases.

Miles, Herbert W[illiam]

Potato leaf-curl. Kirton Agric. Inst. Ann. Rpt. **1923**: 33–37, 1923.

Data on yields.

Miles, L[ee] E[llis]

The mosaic of sugar cane in Mississippi. Mississippi Agric. Expt. Sta. Bull. **191**, 11 p. 1920.

Gives symptoms, distribution, quarantine and control measures.

Milhoffer, S.

Die mosaikkrankheit des tabaks. (The mosaic disease of tobacco) D. Landw. Presse **30**: 600, 1903.

Miller, Justus

Northern Ontario seed potato trade. Potato Mag. **1**: 33, 34, 1919.

Miller, P[hilip] & Martyn, T[homas]

Gardeners and Botanists' Dictionary. **4**: (Under Solanum). 1807.

Milward, J[ames] G[arfield]

Mosaic control by tuber indexing methods applied to the Triumph variety. Proc Ann. Meetg. Potato Ass'n Amer. **14**: 88–91, 1928.

Mitra, M.

Disease of plants. Impt. Inst. Agr. Res. Pusa Sci. Rept **1929-30**: 58–70, 1930.

Reports sterility of "rahar" *Cajanus indicus* of possible virus origin.

Mogendorff, N[ico]

Fern-leaf of tomato. Phytopathology **20**(1): 25–46, 1930. (Rev. Appl. Mycol. **9**: 417, 1930.)

The typical fern-leaf symptoms were not produced with the virus from tomato and tobacco mosaic plants. It was rarely produced by artificial inoculation with cucumber mosaic and regularly by *Myzus persicae* which had fed on mosaic cucumber plants.

Molisch, Hans

Das Plasmamosaik in den Raphidenzellen der Orchideen *Haemaria* and *Anoectochilus*. (Plasma mosaic in raphid cells of the orchids *Haemaria* and *Anoectochilus*.) Sitzungsher. K. Akad. Wiss. Wien (Math.—Nat Kt.) **126**: 231–242, 1917.

Molz, E.

Auftreten der Mosaikkrankheit bei zuckerrüben. (The mosaic disease threat to sugar beets.) Landw. Wachenschr. Sachsen u. Anhalt **28**: 637, 1926.

Mosaikkrankheit der Zukerrübe eine in Deutschland neue und gefährliche Zuckerrübenkranheit. (Mosaic disease of sugar beet a new and dangerous disease of sugar beet.) Deutsch. Landw. Presse **53**(40): 501, 1926. (Landw. Wochenschr. Prov. Sachsen u. Anhatt **28**: 688–689, 1926.)

Eine neue ud gefährliche Zuckerrübenkrankheit. Die Mosaikrankheit der Zuckerrübe. (A new and dangerous disease of sugar beet. The mosaic disease of sugar beet.) Die Umschau **31**: 293–296, 1927.

Moore, E[nid] S[tella]

Diseases of Virginian tobacco in South Africa. Journ. Dept. Agric. Union S. Africa. **12**: 428–455, 1926.

Mosaic of Virginia tobacco. Farming in South Africa. **1**(12): 450-452, 1927.

A popular discussion.

A virus disease of tobacco in South Africa. Nature **129** (3258): 544, 1932.

The disease resembles but is not the same as ringspot. It can be transmitted by grafting and by thrips (*Frankliniella sp.*) and rarely by needle punctures but not by the common green aphids. It appears to be the same as the spotted wilt of the tomato in Australia and virus diseases of *Datura Stramonium*, *Physalis spp.* and *Nicandra physalodes*.

The kromnek or Kat River disease of tobacco and tomato in the East Province (South Africa). South Africa Dept. Agric. Sci. Bull. **123**, 28 p., 1933.

Extensive account of this virus disease of wide-spread occurrence in South Africa.

Important to tobacco growers. The crinkly dwarf menace of tobacco. Farming in South Africa 8(88): 276, 1933.

Popular notes warning the tobacco growers about the crinkly dwarf-disease of tobacco, practically unknown in South Africa a few years ago. Symptoms, etiology and control measures are given.

Moquette, J. P.

Sets over Sereh en over de Gelestrepenziekte. Arch. voor de Java Suiker Indus. **2**: 346–356, 1894.

Mordaunt, Charles

Experiments in practical agriculture. Young's Ann. Agric. **14**: 444–450, 1790.

Reference to a potato disease which may be due to a virus.

Mori, Nello

Sulla nature dei filtrabili. (The nature of filterable virus.) Reale Inst. d'incoraggiamento di Napoli, n. d.

Morren, E.

Contagion de la panachure. (Contagion variegation) Belg. Hort. **20**: 14–19, 1870.

Historical value only.

Morris, H[arry] E[lwood]

Virose or degeneration disease of potatoes in the northwest. Proc. Ann. Meeting Potato Ass'n Amer. **15**: 199–203, 1929.

------------, **& Young, P[aul] A[llen]**

Potato diseases in Montana. Montana Agric. Expt. Sta. Bull. **227**, 51 p., 1930.

The object of this paper is to facilitate the identification of potato diseases. Among those described and tabulated there are a considerable number of virus diseases.

Morse, E. W.

On the power of some peach trees to resist the disease called "Yellows" Bul. Bussey Inst. **3**: 12, 1901.

Morse, Stanley F[letcher]

Mosaic neglect dangerous. Facts. About Sugar **19**(2): 42, 1924.

Morse, W[arner] J[ackson]

Potato disease in 1907. Maine Agric. Expt. Sta. Bull. **149**: 289–330, 1908.

Observations upon a yellow disease of the fall dandelion. Science n.s. 28(715): 348, 1908.

Record of the occurrence of a disease on *Leontodon autumnale* Linn. in Maine, which the author compares with aster yellows and of course has the characteristics of a virus disease.

Recent progress in potato diseases work in Maine. Agric. of Maine, 1916, p. 246–258, 1916.

Morstatt, H[ermann Albert]

Uebersicht über die Krankheiten und Schädling der Kulturpflanzen. (Review about diseases and pest of cultivated plants.) Der Pflanzer p. 184–194, 1913.

Notes on virus diseases of cassava and peanuts

Die Degeneration bei unseren Kulturpflanzen. (Degeneration in our crop plants.) Blätt Pflanzenbau. u. Pflanzenzücht. 1: 49–51, 1923.

Viruskrankheiten der Pflanzen. (Virus diseases of plants.) Pflanzenbau 1: 57–58, 1924.

Entartung, Altersschwäche und Abbau bei Kulturpflanzen, insbesondere der Kartoffel. (Degeneration, senile decay, and running out of cultivated plants, especially the potato.) Verlag. Dr. F P. Datterter & Co., Freisiug–München, 74 p. 1925.

Der gegenwärtige Stand unserer kenntnis der Degeneration. Angeu. Botanik 13: 81–83, 1931.

Mosséri, V[ictor M.]

La chlorose de la canne á sucre en Egypte. (Sugar cane chlorosis in Egypt.) Bull. Inst. Egypte 3: 1–12, 1921. (Bull. Union Agric. Egypte 18: 75–86, 1921.

Mottet, S[éraphin Joseph]

Dégénérescence de la Pomme de terre par le semis. (Degeneration of the potato by the seed.) Journ. Agric. Pract. 31: 1, 1917.

La dégénérescence des pomme de terre. (Degeneration of potato.) Journ. Agr. Pract. 31: 327–329, 1918.

La dégénérescence des pomme de terre. (Degeneracy of potatoes.) Journ. Agric. Pract. n.s. (France) **33**(14): 237–239, 1920.

Moutia, A.

Sur un des modes de transmission de la mosaïque du tabac. (A manner of tobacco mosaic transmission.) Rev. Agric. Ile Maurice **40**: 179–180, 1928.

Muir, Frederick Arthur Godfrey, & Swezey, Otto H[erman]

Entomology. Report Comm. Experiment Station. Hawaii Sugar Planters' Association **1925–26**: 16–29, 1927. (Rev. Appl. Ent. ser. A **15**: 431, 1927.)

Mulder, E[mile]

Cultivation of tobacco in Sumatra. U. S. D. A Div. Veg. Phys. & Path. Report **58**, 1898.

Müller,

Vechselseitige Uebertragbarkeit der verschiedenen Viruskrankheiten des tabaks, der tomate und der Kartoffel innerhalb der Famile der Solanaceen Inaugural dissertation, Bonn. 72 p., 1930.

Muller, D.

Die assimilation der blattrollkranken kartoffelpflanzen. (The assimilation of leaf roll-diseased potato plants. Planta. **16** (1): 10–15, 1932.

The stomatal apertures were narrower in diseased than in healthy plants, the respiratory intensity was equal but the carbon dioxide assimilation was much less in the diseased plants.

Muller, H[ans] C[arl,] & Störmer, K[urt]

(Investigations in plant diseases.) Ber. Agric. Chem. Kentroll u Vers. Stat. Pflanzenkrank. Prov. Sachsen, p. 71–84, 1910.

Muller, H. R. A.

Mosaiekziekte bij cassave. (Mosaic disease of cassava.) Inst. vor Plantenziekten Bull. **24**: 1–17 1931.

Manihot utilissima at Buitenzorg, Java, showed symptoms of mosaic.

Müller, K[url] Rudolf

Eine neue Rübenkrankheit. (A new beet disease.) Deutsche Landw. Presse **56**(33): 469–470. 1929 (Rev. Appl. Mycol. **9** (3): 153–154, 1929. D. Deutsche Zuckerindustr. **54**:1168–1169, 1929. Landw. Wochenschr., Halle **87**: 636–637, 1929.)

Müller, W.

Mosaikkrankheit su Himbeeren. (Mosaic Disease of raspberry.) Mach-richenbl. Deutsch. Pflanzenschutzd. **7**(7): 65–66, 1927.

Mulvania, Maurice

Cultivation of the virus of tobacco mosaic by the method of Olitsky. Science **62**(1593): 37–38, 1925.

The author conducted tests by the methods given by Olitsky but failed to confirm his results.

A special application of collodion sacs (Tobacco mosaic). Abstracts of Bact. **9**(1): 11–12, 1925.

The destructive action of certain bacteria on the virus of tobacco mosaic. Journ. Bact. **11**(2): 98, 1926.

Dialysability of the virus of tobacco mosaic. Phytopathology **16**(11): 853–872, 1926.

Direct sunlight destroyed 90 per cent in 36 hours. Ultra-violet rays gave complete inactivation in one hour. X-Rays had no effect. 80° C. for 20 days did not completely inactivate. Complete inactivation by 88° to 90° C. for 10 minutes. Was not recovered from blood stream of a rabbit. Was inactivated when mixed with blood of a rabbit. Can pass through certain collodion sacs but not through others. Certain bacteria are destructive to it.

Studies on the nature of the virus of tobacco mosaic. Phytopathology **16**(11): 853–871, 1926.

Root inoculation with the virus of tobacco mosaic. Journ. of Bact. (Abstract) **19**(1): 23–24, 1930. (Rev. Appl. Mycol. **9**: 414, 1930.)

This paper gives the results of efforts to inoculate tobacco plants through the roots, all of which were negative. Inoculations through the leaves gave 80 to 90 per cent positive infections.

Mumford, Edward Philpott

On the curly top diseases of the sugar beet: A biochemical and histological study. Summary of results.. Ann. Appl. Biol. **17** (1): 28–35, 1930. (Rev. Appl. Mycol. **9**: 573, 1930.)

The sap of the resistant strains is more concentrated in electrolytes and less concentrated in non-electrolytes and total solids. With one exception the leaves were more acid. The disease caused a decrease

of sugar in both leaves and roots of resistant strains, but in the susceptible strains it caused an increase in the leaves and a decrease in the roots. The amount of sugar may explain the preference of the the insect for the susceptible plants. Phloem necrosis is a symptom of curly top.

The cuticle and epidermis are thicker in the resistant than in the susceptible plants.

Muncie, J[esse] H[oward]

The relation of cucurbit mosaic to wild catnip. Proc. Iowa Acad. Sci. **29**:346, 1922.

Yellow dwarf and moron disease of potato in Michigan. Proc. 18th Ann. Meeting Potato Assoc. Amer. **1931**:70–73, 1932.

Field studies and yield of potatoes with yellow dwarf. A description of the moron disease.

Mungomery, R. W., & Bell, Arthur F[rank]

Fiji disease of sugar cane and its transmission. Queensland Br. Sugar Expt. Sta. (Div. Path.) Bull. **4**, 28 p., 1933.

The history and distribution of the disease, symptoms and a full discussion of experimental studies which led to the discovery that the disease is transmitted by *Perkinsiella saccharicida*.

Muravjev, V. P.*

Die mosaikkrankheiten der Zukerrübe. (The mosaic disease of sugar beet.) Saatzuchtabt. Allruss. Zuckertrust, 280 p. 1930.

Mozaichnye Bolezni Sakharnoi Svekly. (Mosaic disease of the sugar beet.) Kiev., S.S.U. Soiuzsakhara 286 p., 1930.

This work includes contributions from several workers on the subject which are inserted in this bibliography under their corresponding names.

(Materials for studying the mosaic of the sugar beet.) In his Mozaichnye Bolezni Sakharnoi Svekly (Mosaic disease of sugar-beet.) Kiev, S. S. U. Soiuzsakhara p. 113–130, 1930. (English Abstract p. 128–130.)

Description of the behavior of the disease and its effect on yields. No resistant variety has been found.

(Diagnosis of the mosaic diseases of the sugar beet.) In his Mozaichnye Bolezni Sakharnoi Svekly (Mosaic diseases of

* Also—Muraviov, V. P.

sugar beet.) Kiev, S.S.U. Soiuzsakhara p. 131–140, 1930. (Eng. Abstract p. 138–140.)

"A decimal system has been adopted for economy of energy and time in expressing the appearances of designated areas descriptively in the case of mosaic plant surfaces."

(General sketch of mosaic of sugar beet.) In his Mosaichnye Bolezni Sakharnoi Svekly (Mosaic diseases of sugar beet.) Kiev. S.S.U. Soiuzsakara p. 179–262, 1930. (English translation p. 221–261.)

Review of the publications on sugar-beet mosaic in Russia and elsewhere.

Murphy, Paul A[loysius]

Mosaic disease of potatoes. Agric. Gaz. of Canada. **4**: 345–349, 1917.

The economic importance of mosaic of potatoes. Phytopathology (Abstract) **7**(1):72–73, 1917.

----------, **& Wortley, E[dward] J[ocelyn]**

Determination of the factors inducing leaf-roll of potatoes, particularly in northern climates. Phytopathology **8**(4):150–154, 1918.

Recommends that varieties should be separated by spaces of six feet.

Disease of the potato. Nova Scotia Fruit Growers' Assoc. Ann. Rpt. **54**:180–190, 1918.

Potato inspection service. Agric. Gaz. of Canada **6**(3): 1–7, 1919.

Some constitutional diseases of the potato. Canada Hort. **42** (1): 9, 1919.

New or little-known diseases of potatoes which cause running-out of seed. Phytopathology (Abstract) **10**(5): 316–317, 1920.

----------, **& Wortley, E[dard] J[ocelyn]**

Relation of climate to the development and control of leaf-roll of potato. Phytopathology **10**(9): 407–414, 1920.

Gives the results of planting in different places and recommends the use of seed from disease-free districts.

Investigations of potato diseases. Canada Expt. Farms. Bull. **44**, 2 ser., 86 p., 1921.

Some recent work on leaf-roll and mosaic. Roy. Hort. (London). Int. Potato Conf. Rpt. **1921**: 145–152, 1922.

Gives the results of studies with potato leaf-roll and mosaic on starch translocation and climate.

Leaf-roll and mosaic, two important diseases of potato. Ireland Journ. Dept. Agric. **22**: 281–284, 1922.

Leaf-roll and mosaic of the potato in Ireland. Journ. Nat. Inst. Agric. Bot. **1**: 47–50, 1922.

A description of symptoms and results of experiments with insects.

On the cause of rolling in potato foliage; and on some further insect carriers of the leaf-roll disease. Sci. Proc. Roy. Dublin Soc. **17**(20): 163–184, 1923

The author reports an excess accumulation of starch in the leaves as a constant symptom of leaf-roll. The disorganization of the phloem was found in plants that had been attacked by *Phytophthora* and by eel-worms.

Virus diseases of potatoes. Nature (London) **112**(2808): 293, 1923. (Brit. Ass'n Adv. Sci. Rpt. (Abstract) **91**: 492, 1923.)

Investigations on the leaf-roll and mosaic diseases of the potato. Ireland Journ. Dept. Agric. & Tech. Instruction **23**(1): 20–34, 1923.

A brief history of these diseases with the results of the studies on the influence of environment and on insect vectors.

---------, & **Mckay, Robert.**

Investigations on the leaf-roll and mosaic diseases of potato. Ireland Journ. Dept. Agric. **23**(4): 344–364, 1924.

It appears that the transmission of the viruses is not due to aphids alone. There is a discussion of symptoms for the purpose of distinguishing diseases which are confused.

Virus diseases of potatoes. British Assoc. Adv. Sci. Rpt. (Abstract) **1923**: 492, 1924.

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Investigations on the leaf-roll and mosaic diseases of the potato. Ireland Journ. Dept. Agric. & Lands. **25**(2): 138–154, 1925.

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Investigations on the leaf-roll and mosaic diseases of the potato. Irish Free State Dept. Lands & Agric. Journ. **26**(1): 1–8, 1926.

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Methods for investigating the virus diseases of the potato and some results obtained by their use. Sci. Proc. Roy. Dublin Soc. **18**(10–16): 169–184, 1926.

The author describes methods and gives the results of transmission experiments. Four insects were found to be carriers: *Myzus persicae*, *M. pseudosolani*, *Macrosiphum solanifolii*, and *Calocoris bipunctatus*.

Investigations on the leaf-roll and mosaic diseases of potato. Irish Free State Dept. Lands & Agric. Journ. **26**(4): 295–305, 1927.

The insect vectors of the leaf-roll disease of potato. Sci. Proc. Roy. Dublin Soc. **19**(20–28): 341–353, n. s., 1929. (Rev. Appl. Mycol. **9**(3): 197–198, 1930.)

This paper is an extension of previous studies on this subject.

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La production d'un "crinkle" des pommes de terre par un mélange de virus. (The production of "crinkle" of potato by a crossing of virus.) Rapp. Deuxieme Cong. Intern. Path. Comp. **1**: 448, 450, 1931.

Based on three years' experiments the authors state that potato crinkle was produced when simple mosaic was introduced into plants carrying a particular latent virus. The synthetic crinkle thus produced persisted in a form indistinguishable from natural crinkle. During five years experimentation no difference in other respects has been revealed between the two diseases.

A critical review of some recent work on the occurrence of virus complexes in the potato. Sci. Proc. Roy. Dublin Soc. n. s. **20**(18): 193–210, 1932.

---------, & McKay, Robert

The compound nature of crinkle, and its production by means of a mixture of viruses. Sci. Proc. Roy. Dublin Soc., **20** (20): 227–247, 1932.

This paper is the result of three years' work which indicate the compound nature of this disease.

A comparison of some European and American virus diseases of the potato. Sci. Proc. Roy. Dublin Soc. **20**(27): 347–358, 1932.

These studies were made for the purposes of determining the diseases that were common to both continents and the diseases that are distinct.

Murray, J. C.

Report of Field Assistant. Australian Sugar Journ. **16**: 607–609, 611, 1924.

Varietal resistance to mosaic disease in sugar cane.

Murray, P[ercival] W[aterhouse]

Investigations on the leaf-roll and mosaic diseases of potato. Ireland Journ. Dept. Agric. **25**: 1–8, 1926.

Sugar-cane diseases, Jamaica. Jamaica Dept. Agric. Ann. Rpt. **1920**: 13–14, 1920.

Agricultural Experiments. Sugar-cane mosaic disease. Jamaica Dept. Agric. Ann. Rpt. **1923**: 12-14, 1924. (Rev. Appl. Mycol. **4**: 65, 1924.)

Field experiments in the control of mosaic disease of Jamaica. 1923–25, Jamaica Dept. Agric. Microb. Circ. **6**: 16–37, 1926.

Murton, W. A.

Environmental influences in the pathology of *Solanum tuberosum.* Journ. Wash. Acad. Sci. **3**(7): 1913.

Musschenbroek, S. C. van

Gele Strepenziekte (Yellow stripe disease.) Circ. No. **42**, der Soerbaijasche Vereeing van 16. Oct. Bl. 327, 1892.

The first record of the mosaic disease of sugar cane.

Beschrijving van twee tot dusverre in West–Java onbekende sietziekten. (Description of two unknown diseases in West Java up to the present.) Bijlage Arch. v.d. Java Suiker Indus. Overdruppen, p. 113–118, 1893.

Myers, J[ohn] G[olding]

Dry-season studies of cane Homoptera at Soledad, Cuba. Contribution Harvard Inst. Trop. Biol. & Med. **3**: 69–110, 1926. (Rev. Appl. Entom ser. A. **14**: 497–498, 1926.)

Nakata, K., & Takimoto, S.

(Diseases of cultivated plants in Korea.) Journ. Agric. Expt. Sta. Govt. Gen. Chosen **15**, 146 p., 1928.

Narasimhan, M. J.

Note on the occurrence of intracellular bodies in spike disease of sandal (*Santalum album* Linn.) Phytopathology **18**(9): 815–817, 1928.

The author reports the finding of intracellular bodies which supports the virus theory of Coleman.

Cytological investigations on the spike disease of sandal *Santalum album*. Phytopathology **23**(2): 191–202, 1933.

The author describes the results of his cytological studies on spike disease of sandal. He gives special attention to the intracellular bodies observed, describes and compares them.

Narasimhamurthy, N., & Sreenivasaya, N.

Contribution of the study of spike disease of sandal (*Santalum albums* Linn.) VI Nitrogen metabolism in healthy and spiked leaves. Journ. Indian Inst. Sci. **12A**(10): 153–163, 1929.

Neal, David C[arleton]

Phony peaches: A disease occurring in Middle Georgia. Phytopathology **10**: 106–109, 1920.

A description of the disease.

————————, **& Wallance, J. M.**

Sweet potato mosaic. Mississippi State Plant Bd. Quart. Bull **4**: 6–10, 1924.

————————, **& Barker, H[enry] D.**

Important tomato diseases of Mississippi. Mississippi State Plant Bd. Quart Bull. **4**(1): 7–24. 1924.

Needham, Charles W.

The breaking of tulips. Garden (London) **89**: 599–600, 617-618, 1925.

Popular account of the disease.

The breaking of tulips. Gard. Chron. **79**(3): 298–299, 1926

Abstract of lecture before the Wakefield Paxton Society describing the disease.

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Breaking in tulips. Gard. Chron. **92**: 44–45, 1932.

Neger, F[ranz] W[ilhelm]

Die Blattrollkrankheit der Kartoffel. (Leaf roll disease of potato.) Deut. Landw. Presse 45(76): 469–470, 1918.

Die Blattrollkrankheit der Kartoffel. (Potato leaf-roll disease.) Ztschr. Pflanzenkrank. **29**(1–4): 27–48, 1919.

The author discusses the etiology of the disease and the physiology of the plant, also the translocation of starch in sound and diseased potatoes.

Gesichtspunkte für die Bekämpfung der Blattrollkrankheit der Kartoffel. (View points in the fight against the leaf roll disease of potatoes) Der Kartoffelbau **3**(11); 1919.

(Control of potato leaf-roll.) Sachs. Landw. Forstwischr. **68** (27): 271–272, 1920.

Nelson, Ray

Transference of the bean-mosaic virus by *Macrosiphum solanifolii*. Science n. s. **56**: 342–344, 1922.

Gives the results of studies which indicate that *M. solanifolii* is the carrier of the virus.

The occurrence of protozoa in plants affected with mosaic and related diseases. Michigan Agrc. Expt. Sta. Tech. Bull. **58**, 30 p., 1923. (Phytopathology (Abstract) 13(1): 41, 1923.)

A histological study which leads to the belief that the disease is due to a protozoan closely related to *Leptomonas*.

Chrysanthemum yellows, a new disease in the greenhouse. Michigan Agric. Expt. Sta. Bull. **7**(4): 157–160, 1925.

Cytological and biological investigations of bean mosaic. Journ. Bact. (Abstract) **19**(1): 22, 1930. (Rev. Appl. Mycol. **9**(7): 423, 1930. Phytopathology **20**: 133, 1930.)

The author reports the finding of bacteria in the chloroplasts, cytoplasm, phloem, xylem, and parenchyma tissues. The chloroplasts are destroyed and the bacteria found in the plastid detritus.

Infectious chlorosis of the rose. Phytopathology (Abstract) **20** (1): 130, 1930.

Correlative studies on the bacteriology of bean mosaic and seed transmission of the virus. Phytopathology (Abstract) **21**(1): 116, 1931.

Investigations in the mosaic disease of bean (*Phaseolus vulgaris*) Michigan Agric. Expt. Sta. Tech. Bull. **118**; 71 p., 1932.

The disease reported from Russia by Iwanowski in 1899, from United States by Clinton in 1908, attacks all commercial varieties and *P. vulgaris* var. *humilis*, *P. acutifolium* var. *latifolius*, *P. angularis*, *P. coccinelus*, *Vicia faba* and *Vigna sesquipedalis*. It is transmitted by *Macrosiphum solanifolii* (*M. gei*) and the leaf hopper, *Empoasca fabae*.

------------, & Down, E. E.

Influence of pollen and ovule infection in seed transmission of bean mosaic. Phytopathology (Abstract) **23**(1): 25, 1933.

Neuwirth, F[rantisek]

Die Kräuselkrankheit der Zuckerrübe. (The curling disease of sugar beet.) Rudschau, Zeitschr. f. Zuckerind. Prag. **4**, 14 p., 1926.

Newcombe, Frederick C[harles,] & Lee, H[enry] Atherton

The cause of sectional chlorosis of sugar cane. Hawaii Planters' Rec. **31**: 125–128, 1927.

Newhall, Allan G[oodrich]

Seed transmission of lettuce mosaic. Phytopathology **13**(2): 104–106, 1923.

This paper gives evidence that this disease is carried in the seeds.

Newman, C[harles] C[arter,] & Leonion, M. S.

Irish potato breeding. South Carolina Agric. Expt. Sta. Bull. **195**, 28 p., 1918.

Newton, W[illiam]

Infectious chlorosis of roses. Canada Dept. Agric. Div. Bot. Rpt. Dom. Botanist for the year 1930, p. 23, 1931.

A record of the presence of this disease.

Nishimura, Makato

A carrier of the mosaic disease. Bull. Torrey Bot. Club **45**: 219–231, 1918.

The results of a series of inoculations experiments demonstrating that *Physalis alkekengi* is a symptomless carrier of a mosaic disease.

Noble R[obert] J[ackson]

Some observations on the woodiness or bullet disease of passion fruit. Journ. Proc. Roy. Soc. New South Wales **62**: 78–79, 1928.

Spotted wilt in tomatoes. Agric. Gaz. New South Wales **39** (1): 59–63, 1928.

Brief popular description of the comparatively new virus disease.

Woodiness of Passion fruit. Cause of the disease discovered. Agr. Gaz. N. S. Wales **39**(9): 681–683, 1928.

Account of this disease in New South Wales. Description and nature of the disease. The author states that it is due to the action of a virus and is of infectious character. Gives control measures.

Biologist—New South Wales Dept. Agric. Ann. Rpt. **1927–28**: 16, 1929. (Rev. Appl. Mycol. **9**(1): 18, 1930.)

Australia: success in control of bunchy-top disease of banana in New South Wales. Internat. Bull. Plant Protect. **7**(9): 195, 1933.

Brief notes on production, damages and control in regard to bunchy top of bananas in Australia.

Nolla, J[osé] A[ntonio] B[ernabé]

Las enfermedades del tabaco en Puerto Rico. (Tobacco diseases in Puerto Rico.) Ins. Expt. Sta. Puerto Rico Bull. **39**, p. 24–25, 1932.

Brief notes on tobacco mosaic. The author states that the disease affects the quality more than the yield. Gives nature and cause, of the disease, symptoms and treatment.

------------, & Roque, Arturo

A variety of tobacco resistant to ordinary tobacco mosaic. Journ. Dept. Agric. Puerto Rico **17**(4): 301–303, 1933.

A preliminary report. The variety was introduced from Colombia, Valle del Cauca, in 1929, by the senior author.

Noordanus, G.

Mosaiekziekte der frambozen. (Mosaic disease of raspberry.) Floralia **47**(30): 472–473, 1926.

A brief note given on the occurrence of mosaic on raspberries in Holland. Gives degree of susceptibility of different varieties.

Norris, Roland V[ictor]

Spike disease of sandalwood. Nature **126**(3174): 311, 1930.

A review of recent progress in the study of this disease. The susceptibility of the sandal tree may be influenced by the host in which it grows.

North, D[avid] S[utherland]

The control of sugar-cane diseases. Australian Sugar Journ. **14**(12): 687–693, **15**(1): 9–24, 73–83. (Int. Sugar Journ. **26** (310): 522–528, 1924. Rev. Appl. Mycol. **2**: 578–581, 1923.)

This is a popular paper containing some data on virus disease.

Norton, J[ohn] B[itting] S[mith]

Irish potato disease. Maryland Agric. Expt. Sta. Bull. **108**: 63–72, 1905.

Report of the State Pathologist for 1910. Maryland State Hort. Soc. **13**: 138–154, 1910.

Loss from mosaic disease of tomato Phytopathology (Abstract) **4**(6): 398, 1914.

Peach yellows and peach rosette. California Comm. Hort. Mon. Bull. **6**(7): 282–286, 1918.

Mosaic diseases and their control. Maryland Agric Soc. & Maryland Farm Br **8**: 374–378, 1924.

-------------, **& Heuberger, J. W.**

Factors influencing type and sequence of tomato mosaic leaf abnormalities. Phytopathology (Abstract) **23**(1): 26, 1933.

Novinenko, A. I.

(Insects as carriers of mosaic disease of sugar beet. Preliminary note.) Prot. Plants Ukraine **3–4**: 164–168, 1928.

(Insect vectors of sugar-beet mosaic.) Cent. Zuckerindus. **38**: 400–401, 1930 (Facts About Sugar **25**(19): 467, 1930.)

Insects as carriers of mosaic disease of sugar beet. Pub. Plant Breed. Dept. Sugar Union. Kiev. **3**: III, 1930. (Stanz. Ent. Otd. **13**, 15 p., 1930)

(The insects as transmitters of mosaic disease of the sugar beet.) In V. P. Muraviov, Mozaichnye Bolezni Sakharnoi Svekly (Mosaic diseases of sugar beet.) Kiev, S.S.U. Souzsakhara p. 99–111, 1930. (English Abstract p. 111.)

Transmission experiments showed that the *Aphis fabae* gave a high percentage of infection as carrier of the disease. The bug *Poeciloscytus cognatus* proved to be less active. As the transmission

does not occur at a distance greater than 700 m. the author recommends the planting of sugar beet isolated at that distance from infested fields and susceptible weeds and to keep the plantation free of insects capable of transmiting sugar-beet mosaic.

Nowell, W[illiam]

Sugar-cane diseases in Puerto Rico Agric News (Barbados) **16**(393) ·158, 1917

A comment to the Fifth Annual Report (1916) of the Insular Experiment Station of Puerto Rico, written by John A Stevenson.

Mosaic disease of sugar cane Agric News (Barbados) **19**(462): 14, 1920

A review of the United States Department of Agriculture Bulletin No. 829 by Brandes and Bulletin No 19 of the Insular Experiment Station of Puerto Rico by F S Earle

Eradication of mosaic disease in Trinidad Trinidad and Tobago Dept Agric Bull **19** 105–106, 1921

Diseases of crop plants in the Lesser Antilles, p 325, 1923

This book contains much data on virus diseases.

Oberstein, [Otto]

Die Kräuselkrankheit der Zukerrube in America und die neueren Theorien der Blattrollkrankheit der Kartoffel (The curly-leaf disease of sugar beet in America and the new theories of the leaf-roll disease of potatoes) Nachrichtenbl Deutsch Pfl Schutzd. **3**: 35, 1923.

Ocfemia, G[eraldo] O[ffimaria]

Progress report on bunchy-top of abacá or Manila hemp Phytopathology **16**(11) 894, 1926.

This disease is caused by a virus and is carried by an Aphid, *Pentalonia nigronervosa*

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Second progress report on bunchy-top of abacá or Manila hemp. Phytopathology **17**(4): 255–257, 1927.

The heart rot of this plant is sometimes the last stage of bunchy-top. Bunchy top, due to other causes, is different from bunchy-top caused by the virus.

Bunchy-top of abacá or Manila hemp I A study of the cause of this disease and its methods of transmission Amer Journ Bot. **17**(1). 1–18, 1930.

This paper is a very thorough discussion of the symptoms, effects and transmission of this disease.

Save the abacá industry from ruin by bunchy-top: The Philippine Agric. **20**(3): 167–169, 1931.

The author gives a warning to the country about the danger of the disease, also gives advise as to the means of overcoming the destructive disease in the producing provinces. States that the disease is of the virus type and transmitted by insects and is dangerous to abacá as well as to bananas.

The bunchy-top of abacá and its control. Phil. Agric. **20**(5): 328–340, 1931.

A continuation of the author's work for the control of bunchy-top of *Musa textiles.*

Notes on some economic-plant diseases, new in the Philippine Islands. Philippine Agric. **19**(9): 581–589, 1931.

A disease of corn which resembles Fiji diseases of sugar cane is described.

(A note) Philippine Agric. **21**(5): 358, 1932. (Sugar News **13**(7): 751, 1932)

In this brief note it is announced that Dr. Ocfemia of the Philippine College of Agriculture found the transmissibility of the Fiji disease of sugar cane by adults of the leafhopper *Perkinsiella vastatrix* Breddin. (Later in Amer. Journ. Bot. **21**(3): 113, 1934, (4th foot note) the author claims that this is the first mention in print of the subject.)

An interesting reaction of a sugar-cane variety to grass mosaic. Philippine Agric. **21**(6): 414–419, 1932.

----------, **Hurtado, Evaristo A., & Hernández, Crispiniano C.**

Distribution of mosaic and Fiji disease in sugar-cane stalks; effects of these maladies on the germination of the eyes and transmission of the viruses by pin pricks. Philip. Agric. **22** (6): 385–407, 1933.

The authors state that mosaic and Fiji diseases are two of the major diseases of sugar cane in the Philippines causing enormous losses to the sugar industry. They describe both diseases. Mosaic is transmitted by *Aphis maidis* Fitch. Fiji disease by *Perkinsiella vastatrix* Breddin in the Philippines, while in Australia it is transmitted by *P. saccharicida* Kirk. They give extensive data of experiments in artificial transmission and germination.

An insect vector of the Fiji disease of sugar cane. Amer. Journ. Bot. **21**(3): 113–120, 1934.

The author reports the results of his experiments under carefully

controlled conditions. He found that the adults of the leafhopper *Perkinsiella vastatrix* Breddin transmitted Fiji disease of sugar cane. The incubation period varied from 8 to 28 days. He describes the symptoms of the disease resulting from the transmission by the leafhopper under observation.

Oehmichen, C., & Hallier, E.

Die Kräuselkrankheit der Kartoffel: I Form und Verbreitung der Krankheit. II. Ursache der Krankheit. (The curl disease of potatoes. I Form and spreading of the disease. II Cause of the disease.) Landw. Presse **2**: 464, 1875.

Beobachtungen über des Auftreten der Kräuselkrankheit der Kartoffeln 1873–1875. (Observations on the behavior of the curl disease of the potatoes 1873–1875.) Zeitschr. Parasitenk **4**: 144–152, 1875.

Ogilvie, L[awrence]

Notes on leaf-roll of potatoes. Agric. Bull. Bermuda Dept. Agric. **3**(12): 1, 1924–25, 1925.

The raising of hyacinths in Holland. Journ. Ministry of Agric. **33**: 248, 1926.

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An important virus disease of *Lilium longiflorum* and its varieties. Nature (London) **119**(2997): 528, 1927.

Aster yellows in Bermuda. A disease of many cultivated plants. Bermuda Agric. Bull. **6**(5): 7–8, 1927.

Virus diseases of plants in Bermuda. Bermuda Agric. Bull. **7**: 4–7, 1928.

A transmissible virus disease of the eastern lily. Ann. Appl. Biol. **15**(4): 540–562, 1928.

The author gives a review of the history of the disease. The disease is carried by *Aphis gossyppi*. It attacks *L. formosum* and *L. giganteum*.

Report of the plant pathologist for the year 1927. Bermuda Dept. Agric. Ann. Rpt. **1927**: 26–37, 1928.

Notes on mosaic disease of banana, Hippeastrum and lettuce.

—————————, & Guterman, Carl E[dward] F[rederick]

A mosaic disease of eastern lily. Phytopathology **19**(3): 311–316, 1929.

There are three types of symptoms of this disease. The symptoms are partly masked by temperature above 70° F. All attempts to transmit by insect or mechanical devices have failed.

Ring spot or spotted wilt of tomatoes and ornamental plants. Agric. & Hort. Res. Stat. Long Ashton, Ann Rpt. **1932**: 121–122, 1933.

Brief notes reporting the occurrence of ringspot or spotted wilt disease on tomatoes, *Streptosolen jamesonii*, *Schizanthus* sp., *Browallia speciosa major*, *Trachelium* sp., begonias, *Campanula pyramidalis* and dahlias.

Oldaker, G. E. W., & Dowson, W[alter] J[ohn]

Potatoes. Virus diseases and clean seed. Tasmanian Journal Agric. **1**(1): 14–18, 1929. (Rev. Appl. Mycol. **9**: 332, 1930.)

Includes descriptions and recommendations of control by growing seed at high altitudes.

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Potatoes. Elimination of virus and other diseases. Care of "seed" from the selected plants. Tasmania Journ. Agric. n. s. **1**: 87–91, 1930.

Potatoes, virus diseases and seed selection Tasmanian Journ Agric. n.s. **2**(2): 91–92, 1931.

Olitsky, Peter K[osciusko]

Experiments on the cultivation of the active agent of mosaic disease of tobacco and tomato. Science n. s. **60**(1565): 593–594, 1924. (Journ Expt. Med. **41**(1): 129–136, 1925.)

The author gives an account of work from which he concludes that he has been successful in growing the organism in culture.

—————————, & Northrop, J. H.

The inoculation of tomato and tobacco plants with potato mosaic virus. Science n.s. **61**(1586): 544–545, 1925.

The authors record the transmission of potato mosaic to tobacco and tomato.

The transfer of tobacco and tomato mosaic disease by the *Pseudococcus citri*. Science n.s. **62**(1611): 442, 1925.

A brief paper giving evidences that this insect transmits the disease.

————————, & **Hoffman, D[onald] C.**

The electric charge of mosaic virus particles. Proc. Soc. Exper. Biol. & Med. **27**(5): 378–379, 1930.

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Concerning an increase in the potency of mosaic *in vitro* Science n. s. **74**(1924): 483–484, 1931.

The authors conclude that—"in view of the outcome of the experiments, we have concluded that the results of our tests cannot with certainty be referred to a true multiplication of mosaic virus."

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The inactivation of mosaic-disease virus by pulverizing infected tissue. Science n. s. **75**(1950): 518–519, 1932.

The authors describe methods and give results of studies by which they conclude that "tomato-mosaic virus loses its infectivity when tissues containing it are comminuted by the methods described."

Oliver y Lugo, Fernando

El mosaico del tabaco y cómo combatirlo (Tobacco mosaic and how to control it.) Rev Agric. Puerto Rico **10**(1): 11–14, 1923.

The author believes that the disease persists in the soil and recommends a three-year crop rotation.

Oortwijn, Botjes, J. G.

Iets over het kweeken van Ziektevoy pootgoed by aardappelen. Bull. of Direcie van den Landbouw te s-Gravenhage, 1919

Raising phloem-necrosis and mosaic free potatoes, and a source of infection whose nature has not yet been elucidated. Phytopathology **10**(1): 48–49, 1920.

Gives recommendations for planting to obtain disease-free seed.

Die Blattrollkrankheit der Kartoffelpflanze. (Potato leaf-roll.) Inang. Diss: Landw. Hochsch. Wageningen, 1920, p 16, 1920.

A very thorough discussion of symptoms.

De bladrolziekte van der Aardappelplant. (Potato leaf-roll disease.) 8, 136 p., Wageningen, 1920.

Het gebruik van ourijpe aadappelknollen als pootgoed. (The use of unripe potato tuber for seed.) Culture **34**: 173–185, 1922. **35**: 279–288, 1923.

Tubers that are harvested early will produce fewer diseased plants than tubers that are harvested late. This is because of a greater number of insect vectors in the late than in the early season.

The potato selection farm at Oostwold, Rpt. Int. Conf. Phytopath. & Econ. Ent. Holland p. 142–147, 1923. H. Veenman & Sons, Wageningen.

The methods and results of seed selection.

Onbekende fetoren bij het kweeken van Ziektevrij pootgoed. (Unknown vectors in the propagation of disease-free seed.) Tijdschr. over Plantenziekten **29**(7) : 113–126, 1923.

Het vroeg rooien van voor pootgoed bestemde aardappelen. (Early digging of seed potatoes.) Tijdschr. Plantenz **29** : 132–133, 1923.

Die Verwendung unreifer kartoffeln als Saatgut. (Blattroll und Mosaikkrankheit.) Deutsche Landw. Presse **51** : 104, 1924.

Het optreden van bladol-en mosaiekziekten in den nabouw van gezonde Aardappelplanten, die op grooten afstand groeien van zieke plants. (The occurrence of leaf-roll and mosaic disease in the progeny of healthy potato plans grown at great distance from infested plants.) Tijsdschr. Plantenz **31**(1) : 1–6, 1925.

The disease was transmitted from diseased to healthy plants over 1,200 meters.

Iets omtrent de beteekenis van enkele aardappelziekten en vooral van het licht mosaiek bij verschillende rassen. Landbouwkundg. Tijdschr. **40**(483) : 687–692, 1928.

Kartoffelkrankheiten und abbau. Mitt. der D. L. G. **44** : 870–872, 1929.

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Top-necrosis in the potato. Phytopathology (Abstract) **20**(1) : 138–139, 1930.

Empfänglichkeit von Kartoffellsorten gegen Viruskrankheiten. (Susceptibility of potato varieties to virus diseases.) Landbonwkundige Tiddschr. **509**(42) : 517–529, 1930. (Fortschr. der Landw. **6**(5) : 173, 1931.)

· The author failed to reveal complete immunity in any variety of potato. Different varieties contracted different virus diseases.

Verzwakking van het virus der topnecrose, en verworven immuniteit van Aardappelrassen ten opzichte van dit virus. (Attenuation of the virus of top necrosis and acquired immunity of potato varieties in respect of this virus.) Tijdschr. over Plantenziekten **39**(10): 249–262, 1933.

Report of results obtained by grafting tuber cores on apparently healthy potato varieties.

Orian, G.

Les maladies de la canne á Maurice. (Sugar-cane disease in Mauritius.) Rev. Agric. de L'Ile Maurice **1929**: 206–210, 1929. (Rev. Appl. Mycol. **9**: 340, 1930.)

This paper contains a brief reference to the streak disease.

Orton, C[layton] R[oberts], & Mc Kinney Jr, W[illiam] H.

Winter blight of the tomato. Pennsylvania Agric. Expt. Sta. Ann. Rpt. **1915**: 235–246, 1915.

A report of studies on the disease; at that time the disease was not known to be due to a virus.

Orton, W[illiam] A[llen]

Environmental influence in the pathology of *Solanum tuberosum*. Journ. Wash. Acad. Science. **3**: 180–190, 1913.

A brief discussion of some of the virus diseases of potatoes.

Potato leaf-roll. U. S. D. A. Br. Plant. Indus. Circ **109**: 7–10, 1913

Description and control measures.

Leaf-roll, curly-leaf and other potato diseases. Phytopathology (Abstract) **3**(1): 69, 1913.

Potato wilt, leaf-roll and related diseases. U. S. D. A. Bull. **64**: 48 p., 1914.

History, description, character, geographical distribution, theories as to cause, methods of control. Also a brief discussion of curly-dwarf.

Inspection and certification of potato seed stock. Phytopathology (Abstract) **4**(1): 39–40. 1914.

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Pecan rosette. Journ. Agric. Res. **3**: 149–174, 1914.

History, distribution, symptoms and experiments. Believe it to be a non-infectious chlorotic disease.

Streak disease of potato. Phytopathology **10**(2): 97–100, 1920.

The author gives a description of the disease and discussion of varietal resistance.

New work in potatoes diseases in America Roy Hort Soc Int Potato Conf Rpt **1921** 169–179, 1921

An early report on infectious chlorosis Phytopathology **14** 189–199, 1924

The writer quotes an early record of 1715.

Osborn, H. T.

Incubation period of pea mosaic in *Macrosiphum pisi* Phytopathology (Abstract) **24**(1) · 15, 1934

Osterspey,

Ein Versuch uber Einfluss der Dungung auf der Blattrollkrankheit und den Ertag der Kartoffeln (An experiment on the influence of manure on the leaf roll disease and on the yield of potatoes) Mitt D Landw Ges **26** 222–224, 1911

Otero Braquertt, J[osé]

Unas palabras sobre la enfermedad de la caña "El matizado" o "Rayas amarillas" (A few words about the sugar-cane disease mottling or "yellow stripe") Rev Agric Com & Trabajo, Cuba, **7**(4) 46–54 1924

Sobre la enfermedad de la caña "El mosaico" o "Rayas amarillas" (About "mosaic" or "yellowstripe" disease of sugar cane) Rev Agric Com y Trab Cuba, **7**(4) 54–56, 1924.

Page, R. L.

The future of Uba cane in Puerto Rico Memoirs Ass'n Sugar-Cane Tech, Puerto Rico 1(1) 25–27, 1922 (Facts About Sugar) **15** 420–421, 1922

A brief reference to varietal resistance and susceptibility.

La enfermedad del matizado, su extirpación y control (The mottling disease, its eradication and control) Rev Agric Puerto Rico **11**(1) · 19–22, 1923 (Australian Sugar Journ) **15**(7) · 428–429, 1923. Facts About Sugar **17**(1) : 14–15, 1923.)

Fields have been practically freed from mosaic by roguing.

Pagliano, T[héophile] C[arles] L[ouis]

Quelques maladies de cotonnier. (Some diseases of cotton.) Rev. Hort. Tunisie **23**: 225–227, 1925.

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Stripe disease of tomatoes. Journ. Min Agric. **26**(10): 998–1000, 1920.

Palm, B[jörn] T[orvald]

De mosaickziekte van de tabak een Chlamydozoonose? (Is the mosaic disease of tobacco a Chlamydozoonose?) Medan Sumatra. Deli Proefstat. Bull. **15**: 7–20, 1922.

A study which leads to the describing of what the author believes to be a chlamydozoon under the name of *Strongyloplasma Iwanowskii.*

Bestrijding van plagen en ziekten in the tabakscultuur. Verslag van een sturdiereis in Europe en de Vereenigde Staten. (Combating pests and diseases in tobacco. Report of a study trip in Europe and United States) Medan Sumatra Deli Proefstat. Ann. Rpt. **1922–23**: 53–54, 1923

Pantanelli, En[rico]

Sui caratteri dell'arricciamento e del mosaico della vite Sepans. Malpighia, an XXV. 56. Catania 1912.

Sulla causa del mosaico della piante. (The cause of mosaic disease of plants) Boll. Meno. R. Staz Patl. Veg (Rome) **1**(3–4): 41–41, 1920.

The author reports that the mosaic of *Hypochaeris radicata* is caused by *Macrosiphora tussilaginis.*

Pape, H[einrich]

Das verheerende Auftreten der Krauselkrankheiten bei Pelargonien. Die Gartenwelt **31**(22): 329–331, 1927

Eine neue Krankreit des poinsettie. (A new disease of poinsettia.) Gartenwelt **31**: 772–773, 1927.

Mosaikkrankheit bei Rhododendron. Gartenwelt **35**(45): 621, 1931.

Zur Kräuselkrankheit der Poinsettie. (The curl disease of Poinsettia.) Gartenwelt **35**(52): 716, 1931.

Mosaikkrankheit an Glieder-, Blatt-und Rutenkakteen. (Mosaic disease of joint-leaf-and twig Cactaceae.) Gartenwelt **36**: 707–708, 731–732, 1932. (Zentralb. für Bakt (Abstract) Ab. 2, **88**(13–16): 349, 1933.)

Description of a mosaic disease of cactus occurring in Germany. Gives methods of control and the following list of species affected: *Epiphyllum truncatum* (Deutsche Kaiserin), *E. harrisonii*, *E. hybridum rubrum*, Meteor, President Grevy, *E. rosa amabilis*, *E. salmoneum*, Vesuvius, *E. violaceum superbum*, *E. bridgesii*, *Phyllocactus gaertneri* var *mackoyanus* and *Rhipsalis rosea*.

Paravicini, Eugen

Die Kartoffelkrankheiten in Niederlanddisch "Ost" Indian. (Potato diseases in the Dutch East Indies.) Centr. fur Bakt. **58**: 212–220, 1923.

Parisot

Recherches sur la filosité de la Pomme de terre. (Researches about the "filosité" of the potato.) Ann. Ecole Not. Agr. Rennes 4, 1910.

Park, M[alcolm]

Report of the Mycological Division. Ceylon Dept. Agric. Tech. Rpts. **1928**: 1–6, 1929. (Rev. Appl. Mycol. 9(2): 88, 1930.)

This paper contains a record of mosaic on eggplant and okra.

Matters of phytopathological interest during 1929. Trop. Agric. (Ceylon) **74**(4): 195–199, 1930.

Banana bunchy top is reported.

Some diseases of plantains in Ceylon. Trop. Agric. Ceylon, **75** (6): 347–353, 1930.

The etiology of bunchy top disease is given. It has been known in Ceylon since 1913. Today it is widespread.

The oil treatment of plantain diseases. Trop. Agric. (Ceylon) **81**(2): 86–90, 1933.

Report of treatment of gas oil 0.864 specific gravity for bunchy top in banana.

Parker, E. R., & Horne, Wm. F.

The transmission of avocado sun-blotch. California Avocado Assoc. Yearbook **1932**: 50–56, 1932.

This paper gives the results of grafting and budding experiments which demonstrate that the disease is carried in stock and in scions.

Pascalet, M.

La mosaïque ou lepre du Manioc. (The mosaic or leprosy of manioc.) Agron. Colon. **21**(172): 117–131, 1932.

Passy, P.

Une nouvelle maladie du poirier. (A new disease of the pear tree.) Rev. Hort. **35**: 252–253, 1913. (Intern. Agrar. Techn. Hundschan **4**: 1152, 1913.)

It refers to pear mosaic.

Patch, Edith M[arion]

Rose bushes in relation to potato culture. Maine Agric. Expt. Sta. Bull. **302**: 321–344, 1921.

Gives evidence that *Macrosiphum solanifolii* overwinters in rose bushes.

The buckthorn aphid. Maine Agric. Expt. Sta. Bull. **317**: 29-52, 1924.

Aphis abreviata passes the winter on *Rhamnus*. A list of its food plants is given.

Peacock, W[alter] M[iller]

The elimination of virus diseases. Ann. Pat. Journ. **4**: 127–129, 1927.

Peltier, Geo[rge] L(eo)

The "false blossom" of the cranberry. Unpub. Thesis Wisconsin Univ. Library, 24 p., 1910.

Experiments on stem rot at Illinois University. Amer. Florist **40**(1292): 324–327, 1913. (Flor. Ex. **35**(11): 575–577, 1913. Flor. Rev. **3**: (797): 24–26, 1913.)

Diseases of carnation. Flor. Ex. **37**(5): 252–553, (6): 320, (7): 372–373, 1914.

Report of the Illinois Pathologist. Amer. Flor. **41**(1346), 432–434, 1914.

Work at Illinois Florist Experiment Station.—Carnation Diseases. Flor. Rev. **33**(851): 22, 52, 56, 1914.

Carnation disease: In J. H. Dick Commercial carnation culture, New York, p. 237–252, 1915.

A brief account on carnation yellows before the cause of the disease was known.

Illinois Pathologist report. Amer. Flor. **44**(1398): 439–440, 1915.

Stem rot of carnation. Flor. Ex. **39**(10): 539, 1915.

Carnation diseases. Flor. Rev. **35**(901): 14, 1915. (Horticulture 21: 373, 1915.)

Pathologist report. Flor. Ex. **41**(11): 608, 1916.

Carnation diseases. Flor. Rev. **37**(954): 20, 1916.

Carnation yellows. Amer. Flor. **46**(1443): 60–61, 1916. (Flor. Rev. **37**(948): 23–24, 1916.)

Report of observations made by the author; he recognizes that there are several forms of the disease, which he describes briefly. It was transmitted by grafting but not by the seed.

Control of carnation yellows. Amer. Flor. **46**(1455): 725–726. 1916.

Popular.

Carnation yellows. Proc. Amer. Carn. Soc. **25**: 29–35, 1916

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Control equipment for the study of the relation of environment to diseases. Nebraska Agric. Expt. Sta. Res. Bull. **28**, 16 p 1924.

Pemberton, C. E.

Entomology. Report Comm. Expt. Sta. H.S.P.A. **1923–24**: 13 32, 1924

Reports that *Aphis maidis* produces severe symptoms of mosaic on *Syntherisma* sp.

Penhallow, D[avid] P[earce]

Peach yellows. Houghton Farm. Expt. Sta. ser. III **2**: 25–45, 1882.

Gives the results of chemical and microscopical studies of the peach wood, etc. Also discusses external characters, soil and atmospheric influences.

Perreau.

Note sur la Nielle des tabacs. (Notes on the mosaic disease of tobacco.) Bull. Soc. Bot. France **56**(1): 53–54. 1910.

Perret, C[laude]

Les formes de dégénérescence de la Pomme de terre. (Forms of degeneration of the potato.) Notes & Act. R. Sci. No. **632**, Oct. 23, 1920.

Sur les maladies des pommes de terre. (About diseases of the potato.) Ann. Epiphyties **7**: 304–314, 1921.

This paper gives the results of experimental work with fertilizers and at various altitudes.

(The contest against degeneration.) Vie Agric. & Rurale **19**. 180–185, 1921.

La dégénérescence de la Pomme de terre. (Degeneration of the potato.) Bull. Soc. Path. **9**(1): 39–42, 1922.

(Potato leaf roll (Loire). Assoc. France Avanc. Sci. Conf. Compt. Rend. **46**: 884–889, 1922.

Fletrissement des pieds et filosité de la pomme de terre. (Foot wilt and "filosité" of the potato.) Rev. Path. Vég. & Ent. Agric. **10**: 168–171, 1923.

Recherches sur la dégénérescence de la pomme de terre. (Research on potato degeneration.) Ann. Epiphyt. **9**: 61–69, 1923.

La dégénérescence des pomme de terre. (The degeneration of the potato.) La Vie Agric. **23**(30): 61–66, 1923.

Les maladies de la pomme de terre en 1924. (Potato diseases in 1924.) Rev. Vég. et Ent. Agric., **11**(4): 309–316, 1924.

Apropos de la filosité de la pomme de terre. ("Filosité" of the Potato.) (Rev. Path. Vég. Ent. Agric. **13**(24): 319–322, 1926.

La station de sélection des Pommes de terre de la Loire. (The potato selection station of the Loire.) Bull. Off. Agric. Massiff. Central **10**: 83–93, 1929.

Pestana, Antonio Carlos

La caña Uba y la enfermedad del mosaico. (Uba cane and the mosaic disease.) El Mundo Azucarero **12**(11): 328–329, 1925.

(Translated from Journal de Lavoura, Brazil.) (Louisiana Planter **74**(15): 291, 1925.)

Peters, L[eo]

Krankheiten und Beschädigungen des Tabaks. (Diseases and injuries of tobacco.) Mitteil. Kais. Biol. Aust. Land. Fortstraw. **13**: 58–64, 1912.

Describes disease, discusses work of others and gives recommendations for control.

Krankheiten des Tabaks. (Tobacco diseases.) Ber. über die Tätigkeit der Biol. Reichsanst. **1919**: 62, 1920.

Peterson, P[aul] D[onald]

Plastids pigment and chlorophyllase contents of tobacco plants as influenced by three types of mosaic. Phytopathology (Abstract) **21**(1): 119, 1931.

Pethybridge, G[eorge] H[erbert]

Potato diseases in Ireland Ireland Dept. Agric. & Tech. Instruction Journ. **10**(2): 241–256, 1910.

Leaf roll and "curl". Ireland Dept. Agric. & Tech. Instruction Journ. **11**(3): 447–499, 1911.

'Curl and "leaf roll" Ireland Dept. Agric. & Tech. Instruction Journ. **12**(2): 354–356, 1912.

Investigations on potato diseases (Fourth Report). Ireland Dept. Agric. & Tech. Instruction Journ. **13**(3): 445–468, 1913.

Investigations on potato diseases IX–X Ireland Dept. Agric. & Tech. Instruction Journ. **18**(4): 410–416, 1918. **19**(3): 271–272, 1919.

A discussion of the 1918 Ireland crop with special reference to some diseases including leaf roll. It was treated by heating the tuber as a means of prevention. It is claimed that heat did not produce leaf roll.

Potato leaf-roll. Journ. Min. Agric. **31**(9): 863–869, 1924.

'A suspected virus disease of zonal Pelargoniums. Gard. Chro. **92**(2395): 378–379, 1932.

Petri, L[ionello]

Recerche sulle cause dei deperimenti delle vite in Sicilia. I—Contributo allo studio dell'azione degli abbassamenti di temperatura sulle vite in repporto all' arricciamento. (Researches on the cause of the decline of the vine in Sicily. I—Contribution to the study of the vine in relation to the curling.) Mém. R. Statioze Patologia Veg., Roma 212 p., 1912.

Nuave vedute sulle cause dell' arricciamento della vite. (New views about the cause of the curling of the vine.) R. Acad. Linei **27**: 271–275, 1918.

L' arricciamento della vite é una malattia prodotta da protozoi? (Is leaf roll of the vine a disease produced by protozoa? Rendic. Acad. Lincei ser. 8, **32**(5): 395–397, 1923.

Stato attuale di alcuni problemi di fitopatologia. (Present status of certain problems of phytopathology.) Conferenza tenuta in Roma al XVIII Congresso delle Cal. dre Ambulanti di Agricoltura Italiane il 10 Maggio 1924, 16 p., 1924.

Sulle cause dell' arricciamento della vite. (On the cause of leaf roll of the vine.) Boll. R. Staz. Pat. Veg. n. s. **9**(2): 101–130. 1929 (Rev. Appl. Mycol. **9**(2): 83–85, 1930.)

The author gives proof that "arricciamento" (Coutnone, roncet, Krantem and Reisigkrankheit) of the grape vines is caused by a virus.

Sur une méthode pour effectuer les injections de virus dans les feuilles. (About a method to practice virus injection into the leaves.) Second Intern., Cong. Compt. Path. Paris Compt. Rend. Communications **2**: 439–441, 1931.

Method and device is described for injecting mosaic virus into citrus leaves.

Sull "arricciamento" della vite. (The curling of the vine.) Boll. R. Staz. Patol. Veget., (Rome) n. s. **11**(1): 61–83, 1931.

Bodies analogous to x-bodies were seen near the nuclei in root-tip cells. The disease is infectious and is believed to be virus. The filterable virus phase diffuse and produce the degeneration stage in the root tip.

Maculatura interna ereditaria dei tuberi di patata. (Hereditary internal spotting of potato tubers.) Boll. R. Staz. Patol. Veg. **11**(2): 171–175, 1931.

An internal necrosis which is transmitted by the tuber.

Variegatura infecttiva delle foglie di "Citrus vulgaris". (Infectious variegation of the leaves of "Citrus vulgaris".) Risso Bull. R. Staz. Pat. Veg. **11**(2): 105–114, 1931.

Phillips, J[ohn] L[loyd]

Yellows and some other important diseases of the peach. Virginia State Crop & Pest Comm. Circ. n.s. No. 4. 1908.

A popular discussion of peach yellows, peach rosette and little peach.

Peach yellows as it affects nurserymen. Address before American Nurserymen's Association. Milwaukee Wis., June 12, 1908.

A popular discussion giving some losses.

Pieper, [Walter]

Die ursuchen und wirkungen des Kartoffelabbauer. (The causes and effects of potato degeneration.) Illus. Landw. Zeit. **50** (1): 134–135, 1930. (Rev. Appl. Mycol. **9**: 602, 1930.)

This paper discusses the influence of environment on mosaic and leaf-roll.

Pierce, W[alter] H[oward], & Hugenford, C[harles] W[illiam]

Symptomatology transmission, infection and control of bean mosaic in Idaho. Idaho Agric. Expt. Sta. Res. Bull. **7**, 37 p. 1929.

The authors give a discussion of the symptoms, the losses and inoculation experiments. Resistant varieties offer the best method of control.

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A note on the longevity of the bean mosaic virus. Phytopathology **19**(6): 605–606, 1929.

The disease was carried in seed 32 years old.

Viruses of the bean. Phytopathology **24**(2): 87–115, 1934.

Thorough study on variety resistance of bean (*Phaseolus vulgaris*) to virus of common-bean mosaic. The author classifies the viruses and gives the susceptibility of each variety in tabulated form. Gives also data on insect vectors.

Pinazzoli, F[rancesca]

Male della bolla e del mosaico. Boll. Tecn. della coltivazione dei tab. R. Inst. Sperim. Scafati (Salermo) **3**(4): 1–14, 1904.

Pinkhof, Marianne

Untersuchungen über die umfallkrankheit der tulpen. (Investigations on the falling disease of tulips.) Recueil Trav. Bot. Néerlandais **26**: 135–288, 1929. (Rev. Appl. Mycol. **9**: 528, 1929.)

Pitt, W.

On discovering the cause and pointing out the cure for the curl in potatoes. Trans. Soc. Encouragement of Arts, Manuf. & Comm. **8**: 31–34, 1790.

Historical value only.

Discussing curl or degeneration of potatoes. Trans. Soc. Encouragement of Arts, Manuf. & Comm. **8**: 1790.

Historical value only.

Pittman, H[arold] A[mbrose Jacques]

Spotted wilt of tomatoes. Journ. Council Sci. & Indus. Res. (Australia) **1**(2): 74–77, 1927.

The disease is carried by *Thrips tabaci* but the insect may disappear before the development of the symptoms.

Plakidas A[ntonios] G[eorge]

An obscure new disease of the strawberry in California. Phytopathology (Abstract) **15**(11): 730, 1925.

Strawberry yellows, a degeneration disease of the strawberry. Phytopathology **16**(6): 423–426, 1926

A preliminary report giving description and stating that the disease is transmitted by the aphis (*Aphis fragaefolii*) and possibly by the red spider (*Testranychus telarius*).

Strawberry xanthosis (Yellows), a new insect-borne disease. Journ. Agric. Res. **35**(12): 1057–1090, 1927.

The author gives a description of the disease and proof that it is transmitted by *Myzus fragaefolii*. He also reports the finding of bodies which he designates as X and Y.

Strawberry dwarf. Phytopathology **18**(5): 439–444, 1928.

A preliminary report. The evidence indicates that the disease is due to a virus which is carried by *Aphis forbesi*.

Report on strawberry virus disease project. U. S. D. A. Plant Disease Reporter **13**(9) : 129–131, 1929. (Rev. Appl. Mycol. **9**(3) : 193, 1930.)

The "June yellows" of Strawberries. Phytopathology (Abstract) **22**(1) : 22, 1932.

Poeteren, N[icolas] van

Verslag over de workzaamheden vanden plagenziektenbudingen diest in het jaar 1923. (Annual Report of the Phytopathological Service for 1923.) Verslag, en Mededeel. Plantenziekten. Diest Wageningen **34** : 1–66, 1924.

Pompeu de Amaral, A.

Mosaic. Bol. Agr. Sao Paulo (Brasil) **27**(4–5) : 146–156, 1926.

Poole R[obert] F[ranklin]

Celery mosaic. Phytopathology **12**(3) : 151–154, 1922.

The first description of the disease. It is carried by *Mysus persicae.*

Celery mosaic. New Jersey Agric. Expt. Sta. Ann. Rpt. **1922** : 567–568, 1922.

Tomato crop losses may be reduced. New Jersey Agric. (New Brunswick) **6** : 5, 1924.

Popular.

Porter, D. R.

New onion disease in Iowa U.S.D.A. Plant Disease Reporter **12**(8) : 93–94, 1928.

Note on the occurrence of a new virus disease of onions in Iowa.

The infectious nature of potato calico. Hilgardia **6**(9) : 277–294, 1931.

The author reports a calico disease of potato in California which appears to be due to a virus.

Porter, R[upert] H[oward]

Further evidence of resistance to cucumber mosaic in the Chinese cucumber. Phytopathology (Abstract) **18**(1) : 143, 1928.

Reaction of Chinese cucumber to mosaic. Phytopathology (Abstract) **19**(1) ; 85–86, 1929.

A new mosaic disease of cucumber Phytopathology (Abstract) 20(1):113, 1930

The resistance of cucumber to mosaic Phytopathology (Abstract) 20(1)·114, 1930

The reaction of cucumber to types of mosaic Iowa State Coll. Journ Sci 6(1) 95–99, 1931

This paper gives the results of hybridization studies, cross-inoculations and a description of a new type of mosaic

Reaction of tomatoes to mosaic Phytopathology (Abstract) 22(1)·22, 1932

Price, W[illiam] C[onway]

The thermal death rate of tobacco-mosaic virus Phytopathology 23(10) 749–769, 1933

A well illustrated article with tables and time temperature curves showing the thermal death rate of tobacco mosaic virus

Local lesions on bean leaves inoculated with tobacco mosaic virus Amer Journ Bot 17(7) 694–702, 1930 (Boyce Thompson Inst Contrib 2(10) 549–557, 1930)

The author gives the results of experiments showing that when bean leaves were inoculated with tobacco mosaic by rubbing the upper surfaces, necrotic lesions were formed on some and not on others. More virus was recovered from those with lesions than from those without lesions.

Acquired immunity to ring-spot in *Nicotiana* Boyce Thompson Inst Cont 4(3) 359–403, 1932

A thorough discussion of the subject, describing observations made by the author by experimentation. He emphasizes the environmental conditions influencing the disease Gives the species of *Nicotiana* and varieties on which recovery was observed No attenuation of the virus was obtained in cases of recovery; this conclusion was reached by actual experimental inoculations as well as the inoculation on recovered plants which showed no symptoms of reinfection The disease persisted in plants propagated by cuttings through three generations, but was not transmitted through seed. No evidence was obtained from grafting experiments, that acquired immunity in tobacco was accompanied by the production of anti-bodies The symptoms of tobacco mosaic in plants which recover from ring-spot are different from those in plants which recover from ring-spot disease. Certain plants are observed to be killed by ring-spot.

Prince, W.

A short treatise on horticulture, New York, p. 14–15, 1828.

This is the first exact description of peach yellows.

Priode, C[arl] N[eal]

Further studies in the ring-spot disease of tobacco. Amer. Journ. Bot. **15**(1): 88–93, 1928.

This is a continuation of previous studies. The author gives the results of inoculations and some data on the effects of temperature on the virus.

Cuban streak. Phytopathology **23**(8): 674–676, 1933.

Description of the symptoms of a new disease on POJ 2725 and CAC 323 sugar-cane varieties. The disease was named "Cuban streak" and tentatively attributed to a virus. The symptoms are different from those of sugar-cane South African streak. The insect vector of the South African streak *Cicadula mbila* is not known in Cuba.

Pritchett, G. H.

Eradication of Fiji disease at Calamba. Sugar Centr. & Planter News. **2**(10): 413–416, 1921.

Points from cane affected with mosaic disease versus points from healthy cane at Hacienda Soledad owned by Mr. José Yunsay. Sugar Cent. & Planter's News **5**(5): 243–247, 1924. (Rev. Appl Mycol **3**: 609. 1924.)

A comparison of results obtained from the use of healthy and diseased points.

Insect pest and cane diseases. Louisiana Planter **73**(24): 470–473, 1924. (Second Ann. Conf. Philippine Sugar Ass'n. Oct. 1–7, 1924.)

Popular account of Fiji and mosaic disease.

Mosaic disease test of Hacienda Tres Corazones owned by Mr Manuel González, Isabela, Occidental Negros. Sugar Cent. & Planters' News **6**(12): 791–792. 1925. (Rev. Appl. Mycol. **5**(6): 329–330, 1926.)

The principal cane disease and insect attacks affecting the several estates of Negros (Philippines). Sugar News **8**(11): 883–892, 1927. (Rev. Appl. Mycol. **7**: 345, 1927.)

Popular discussion of Fiji and mosaic diseases.

Proida, P. A.

(Mosaic of sugar beet) In V. P. Muraviov, Mozaichnye Boleзni Sakharnoi Svekly (Mosaic diseases of sugar beet.) Kiev S.S.U. Soiuzsakhara p. 11–66, 1930. (English abstract p. 64–66.)

Studies and field observations during 1925–1927. The disease is described. From year to year the disease may be transmitted through the roots, and insects act as carriers. No resistant varieties are known locally and sugar reduction due to the disease has not been estimated.

Prunet, I[gnace] A[dolphe]

La dégénérescence de la pomme de terre. (Degeneration of the potato.) Prog. Agri et Vitie **78**: 9–15, 1922.

Purdy, Helen A[lice]

Attempt to cultivate an organism from tomato mosaic. Bot. Gaz. **81**(2): 210–217 (Contr. Boyce Thompson Inst. Plant Res. **1**: * 146–154, 1926.)

The writer conducted experiments following the methods of Olitsky but failed to find any evidence that the organism multiplied outside the living plant.

Multiplication of the virus of tobacco in detached leaves. Phytopathology (Abstract) **17**(1): 58, 1927. (Amer. Journ. Bot. **15**(1): 94–99, 1928.)

The author inoculated healthy leaves after removal from the plant and gives evidence that the virus increased in these leaves.

The improbability of tobacco mosaic transmission by slugs. Amer. Journ. Bot. **15**(1): 100–101, 1928.

A brief paper giving proof that slugs are not carriers.

Immuniology reactions with tobacco mosaic virus. Proc. Soc. Expt. Biol. & Med. **25**: 702–703, 1928. * (Journ Expt. Med. **49**(6): 919–935, 1929.)

This paper gives the results of experiments along the line of those in practice in the study of virus diseases of animals.

Specificity of the precipiting reaction in tobacco mosaic disease. Contr. Boyce Thompson Inst. **3**(4): 529–540, 1931.

The viruses of tobacco ring spot and cucumber were used as antigens in precipiting tests with anti-serum for virus of tobacco mosaic.

* Appears as Helen Purdy Beale.

Serologic reaction as a means of determining the concentration of tobacco mosaic virus. Phytopathology (Abstract) **23**(1) : 4, 1933. (Rev. Appl. Mycol. **12**: 398, 1933.)

Puttemans, A[rsene]

O "mosaico" da canna de azucar. (The mosaic of sugar cane.) Boll. Min. Agric. Ind. o Com. Brazil **15**(2) : 350–355, 1926. Rev. Appl. Ent. Ser. A. **15**: 67, 1926.)

Putterill, V[ictor] A[rmsby]

Tomato mosaic in South Africa. Plant diseases in the western Cape Provinces. IX Journ. Dept. Agric. South Africa **7**(2) : 131–141, 1923.

Quanjer, H[endrik] M[arius]

Nekrose der kartoffelpflanze, di Ursache der Blattrollkrankheit. (Necrose of potato plant, the cause of leaf-roll disease.) Meded. R. Hoog. Land Tuin-en Boshbouwsch. Wageningen **6**: 41-80, 1913.

————————, **& Oortwijn Botjes, J.**

(Review of experimentation in the Netherlands looking to the control of cereal and grass smuts and stripe disease.) Ztrchr. Pflanzenkrank, **15**(8) : 450–460, 1915.

————————, **Lek, Henrik A[drians] A[braham] van der, & Oortwijn, Botjes J.**

Aard verspreidengswijze en bestrijding van phloeemnecrose (Bladroll) en verwante ziekten. (Nature of spreading and combating phloem-necrose (Leafroll) and allied diseases.) Meded. R. Hoog. Land Tuin en Boschbouwsch. Wageningen **10**: 1–138, 1916. (Gard. Chron. 3 Ser. (1550) : 124, 1916.)

————————, ————————, **&** ————————

Recherches sur la leptonécroses de la pomme de terre et les maladies apparentés, factes de 1907 a 1917. (Researches about the leptonécrose of potato and related diseases, occurring from 1907 to 1917.) Ann. Soc. Agri. **34**: 301–357, 455–494, 1918.

————————, **& Oortwijn, Botjes J.**

L'enroulement des feuilles (Leptonécrose) et la frisolée (mosaïque) de la pomme de terre. (Leaf-roll and curly dwarf of potato.) Ann. Sci. Agron. Francaise et Etrangére **36**: 262–280, 1919.

Appears as Helen Purdy Beale.

Phloem necrosis (leaf-roll) and mosaic (including curly dwarf) are similar. A very lengthy discussion including the results of experiments.

------------, **Dorst, J[acobus] C[ornetis,] Dijt, M. D. & Haar, A[me] W[ilhelm] van der**

De mozaiekte van de sonanceen hare verwantschap met de phloemnecrose en hare beteekenis voor de aardappelcultuur. (The mosaic disease of the *Solanaceae*: its relation to phloem-necrosis and its effect on potato culture.) Meded. van de Landbouw Hoogeschool deel, **17**: 1–74, 1919.

A lengthy discussion of leaf-roll and mosaic. The leaf-roll is the same as phloem-necrosis or lepto-necrosis.

Mosaic disease of the *Solanaceae*, its relation to the phloem-necrosis, and its effect upon potato culture. Phytopathology **10**(1): 35–47, 1920.

Gives the results of experiments demonstrating the similarity of tobacco, tomato and potato mosaic.

Considérations nouvelles sur les maladies de la pomme de terre. (New considerations of potato diseases.) Bull. Soc. Path. Veg. **7**: 102–118, 1920

Guide pour l' inspection aux champs et pour la sélection de pomme de terre (Guides for field inspection and potato selection.) Imp Veeman-Wageningen, Holland, 27 p., 1921.

----------, **& Foex, E[dmund] E[tienne]**

Mission d' études sur les maladies de la pomme de terre, en France. (Mission for the study of the potato diseases in France.) Ann. des Epiphyties, **7**: 267–280, 1921.

New work on leaf curl and allied diseases in Holland. Int. Potato Conference. Roy. Hort. Soc. London **1921**: 127–145, 1921.

This paper is devoted primarily to a discussion of symptoms and of insect transmission.

De degeneratieziekten van de aardappelplant. (Degeneration disease in potato plant.) Vakland voor Biologen **11**: 97–104, 117–121, 1921.

Een proef over de beteeknis van ziekten en ziekteverspreiding bij de pootgoedverwisseling, genomen door het Instituut voor Phytopathologie in 1920 en 1921.) (An experiment on the signif-

icance of disease and disease distribution relative to changing of seed potatoes, conducted by the Institute for Phytopathology in 1920–1921.) Cultura **34**: 135–141, 1922.

The greater the disease the greater the degeneration of potatoes. The greater the number of insects the greater the amount of disease.

General remarks on potato diseases of the curly type. Rept. Int. Conf. Phytopath. & Econ. Ent. Holland, p. 23–28. H. Veenman & Sons, Wageningen, 1923.

Krauselkrankheit and dwarf were used by earlier writers for diseases now known as leaf-roll, stripe, streak and different types of mosaic. The author discusses transmission and overwintering and describes a number of virus diseases of potatoes.

Un nouveau chapitre de la patyologie vegetale reliant cette science á la pathologie animale. (A new chapter in plant pathology connecting this science with animal pathology.) Rev. Path. Veg. et Ent Agr. **10**(50): 22–40, 1923.

So-called "virus diseases" of plants; their symptoms, causation, mode of dissemination and economic importance from a physical point of view. Brit. Ass'n. Adv. Sci. Rpt. (Abstract) **91**: 492–493, 1923.

Standardizing of degeneration diseases of potatoes. Phytopathology **14**(11): 518–520, 1924.

The author discusses pure culture methods and the confusion resulting from overlapping symptoms.

So-called "virus diseases" of plants; their symptoms, causation, mode of dissemination, and economic importance from a physiological point of view. British Assoc. Adv. Sci. Rpt. (Abstract) **1923**: 492–493, 1924.

Kringeriheid bij aardappelen. (Curl disease of potatoes.) Woordr. uit. o. d. Plantenteeltdag 30 Juni en 1 Juli, Wageningen p. 50–54, 1926.

----------, & Elze, D[avid] L[eon]

Achterurtgang van pootgoed van gelijke afstamming in de verschillende vroege-aardappeldistricten. (The degeneration of seed of identical origin in the different early potato districts.) Tijdscr. over Plantenziekten **31**(1): 11–14, 1925.

Waarnemingen over "Kringerigheid" of "vuur" en over "net-necrose" van Aardappelen. (Observations on "sprain" and net-necrosis of potatoes.) Tijdschr. over Plantenziekten **72** (4): 97–128, 1926. (English Summary.)

"Sprain" disease of potatoes is discussed at some length with reference to the work of contemporary investigators. It is stated that some diseases mentioned by others are synonymous with sprain. Brown or rust spots and net-necrosis are not accepted by the author. Attempts to isolate an organism have given negative results. Green manure and complete fertilizers appear to be beneficial while the cultivation of turnips accentuates the disease by inducing conditions in the soil. Varieties resistant to the disease are given.

----------, & Oortwijn, Botjes J.

Aardappelziekten van het "stippelstreepen "topnecrose" type en het vraagsteek der latentie en physiologische specialisatie. (Potato disease of the streak and top necrosis type and the problem of latency and physiological specialization.) Meded. Landbouwhoogesschool Wageningen **33**(7): 3–44, 1929. (Rev. Appl. Mycol. **9**: 481, 1930.)

The "streak" of potato is a complex of virus diseases, including the following:

1. Stipplestreak Atanasoff which in a semi-latent form resembles Murphy's "crinkle". In some varieties it resembles mild mosaic.
   In other varieties it is entirely masked.
2. Stipplestreak Koksiaan.
3. Stipplestreak Noordeling resembles crinkle but is not identical.
4. Stipplestreak Eersteling.
5. Topnecrosis latent in Duke of York.
6. Topnecrosis latent in Green Mountain.
7. Topnecrosis latent in the Dutch variety Monocraat.
8. Yellow Dwarf.

The author gives descriptions of all of these diseases.

----------, & Murphy, Paul A.

Proposal for coordinating researches on the virus diseases of the potato. Proc. Int. Cong. Plant Sci. (Ithaca, N. Y.) p. 122, 1929.

----------, Thung, T. H., & Elze, D[avid] L[eon]

"Pseudonet necrose" van de Aardappel. (Pseudo net necrosis of the potato.) Meded. Landbouwhoogeschool Wageningen. **33**(9): 1–10, 1929. (With English Summary.) (Rev. Appl. Mycol. **9**: 483, 1930.)

The authors report an internal paranchyma necrosis both inside and outside the xylem ring; it is transmitted from the tuber by *Mysus per-*

sicae. There are no foliage symptoms. It is similar to the "hereditary sprain" reported by Fruwirth. Atanasoff believes this disease to be the same as the net-necrosis in America and that it is associated with acuba mosaic. The authors do not agree with Atanasoff. It develops in storage with a rise in temperature from 10° to 20° C.

————————, **& Elze, D[avid] L[eon]**

American and European leaf roll of potatoes. Phytopathology (Abstract) **20**(1): 137, 1930.

————————, **Thung, T. H., & Elze, D[avid] L[eon]**

Pseudonetnecrosis of the potato. Phytopathology (Abstract) **20**(1): 137, 1930.

————————, **& Oortwijn, Botjes J.**

Diseases of the streak type in potatoes. Phytopathology (Abstract) **20**: 138, 1930.

————————, **Thung, T. H., Elze, D[avid] L[eon], & Likhite, V.**

De virusziekten der Planten. (The virus diseases of plants.) Landbouw. **5**(10): 793–836, 1930. (With English summary.)

The methods of classification of plant viruses, and an attempt to classify and name potatoe viruses. Phytopathology **21**(6): 577–613, 1931.

The author secured the cooperation of the leading workers on the subject all over the world. An extensive bibliography is appendixed.

Die selektion der kartoffel und der Euifluss äusserer Umstände, insbesondere der Düngung, auf das Selektionsergebnis. (Potato selection and the influence of external condition, especially of manuring, on the outcome of selection.) Ernährung der Pflanze **27**(1): 1–8, 1931.

The author summarizes recent work by himself and his collaborators.

Methods of identification and differentiation of plant virus. Fifth Int. Bot. Cong. Cambridge, **1930**: 383–386, 1930.

Les maladies á virus des plantes cultivées. (Virus disease of cultivated plants.) Second Inter. Cong. Path. Comp. (Paris) **1**: 339, 1931.

A review of our knowledge of transmission, nomenclature and nature of virus diseases of plants.

Die Autonomie der phytopathogen virusarten. (Autonomy of the plant pathogen of the virus kind.) Phytopath. Zeitschr. **4**(2) : 205–224, 1931.

Important account with special reference to the potato. The author summarizes here his previous views on the nature of the phyto-genic viruses. His opinion in regard to the subject, is to attempt to unite the virus diseases under one collective heading, is opposed to the autonomous charn te of the phytopathogenic viruses.

Tabaks-mosaik en vervante ziekte (Tobacco mosaic and related diseases) Ned. Tidjdschr. Hyg. Microb. Sewl. **5**(4) : 182–191, 1931.

---------., & **Silberschmidt, K[arl]**

Ueber eine komplexe viruskrankheit der Tomato. (About a complex virus disease of tomato.) Phytopath Zeitschr. **5**(1) : 1–98, 1932.

A study of necrosis in some of the complex virus diseases.

A complex virosis of tobacco. Phytopathology (Abstract) **23** (1) : 28, 1933.

Uber eine Komplexe Viruskrankheit des Tabaks. (On a complex virus disease of tobacco) Phytopath. Zeitschr. **6**(4) : 325–333, 1933.

Description of results obtained in continuation of previous work associated with Silberschmidt. The work is based on the effect of inoculating tomato plants with two kinds of virus, namely, ordinary tobacco mosaic and acronecrosis from outwardly healthy potatoes.

Onderzoek naar de vatbaarheid voor plantenziekten. (The investigation of susceptibility to plant diseases.) Tijdschr. over Plantenziekten **39**(10) : 163–167, 1933.

Brief discussion on the possibilities offered by the investigation of varietal susceptibility in the control of plant viruses. Among those mentioned are potato virus disorders.

Quar, Sut Ni.

Observations on mosaic. Facts About Sugar **20** : 183–185, 1925.

Raciborski, M[aryan]

Over serehchtige ziekteverschijnselen (On the sereh disease phenomena.) Arch. Suikerindus. Nederl. Indië **6** : 1021–1026, 1898.

Verlag Ontrent den stact van Sland Plantentium te Buitenzorg over het jaar. p. 73–78, 108–110, 1899.

A new disease of elm. Seventh Nat. Shade Tree Conf. Proc. Ann. Meeting, Aug. 27, 28, 29, 1931, p. 79–82, 1931.

Racicot H[oméra] N[oé]

Report of the Dominion Field Laboratory of Plant Pathology. Ste. Anne de la Pocatiere, P. D. (Report Dominion Botanist for the year 1928 of Botany, Canada Dept. of Agric. **1929**: 199–202, 1930. (Rev. Appl. Mycol. **9**:502, 1930.)

Contains experiments on seed transmission of bean mosaic.

Rama Rao, D. A., & Sreeniyasaya, M.

Contributions to the study of spike-disease of sandal (*Santalum album*. Lin. 4, 5. Part IV. Chemical Composition and spiked sandal stems. Journ. Indian Inst. Sci. **11A**(19): 241–247, 1929.

This paper gives the results of a chemical study of this disease.

Rand, F[rederick] V[ernon], & Pierce, W[illiam] Dwight.

A coordination of our knowledge of insect transmission. Phytopathology **10**: 187–231, 1920.

A very excellent discussion of the subject and a bibliography of 173 titles.

-------------, Ball E[lmer] D[arwin], Caesar, L[awson], & Gardner, M[ax] W[illiam]

Insects as disseminators of plant diseases. I. Result of past investigations. Phytopathology **12**: 225–228, 1922.

Each of the authors discusses a phase of the subject as follows:

I. Results of past investigations by Rand.

II. Systematic relations of carriers by Ball.

III. Control of problems by Caesar.

IV. Urgent problems of the future.

All of these papers which they have quoted, contains brief references to virus diseases.

Pecan rosette: Its histology, cytology and relation to other chlorotic diseases. U.S.D.A. Bul. **1038**, 42 p., 1922.

A very thorough study of the disease with special attention to the histology, cytology and relation to other chlorotic diseases.

Status of pecan rosette. Amer. Nut. Journ. **16**: 56–57, 1922.

Rands, R[obert] D[elafield], & Sherwood, S[idney] F[orsythe]

Yield tests of disease-resistant sugar cane in Louisiana. U. S. D. A. Dept. Circ. **418**, 18 p., 1927. (Rev. Appl. Mycol. **6**: 752, 1927.)

————, ————, & Stevens, F[rederick] D[elos]

Sugar-cane variety tests in Louisiana during the crop year 1926–27. U. S. D. A. Circ. **36**, 1928.) (Rev. Appl. Mycol. **8**(1): 62, 1928.)

This paper gives the results of field mill tests of canes that are mosaic-tolerant to determine their relative values.

————, & Summers, Eaton M.

Studies on apparent recovery of certain sugar-cane varieties from mosaic in Louisiana. Fourth Congress Interna. Soc. Sugar-Cane Technologists, Puerto Rico, 1932. Bull. **123**, 7 p., 1933.

This paper presents some field observations and experimental evidence on apparent recovery from mosaic of commercial sugar-cane varieties in Louisiana.

Rangel, E[ugenio dos Santos]

O combate ao mosaico. (Mosaic disease control.) Bol. Agric. Bahia **1926**: 26–24, 1926.

O combate ao mosaico. (Mosaic disease control.) A. Lavoura **30**: 203–204, 1926.

Rankin, W[illiam] H[oward], Hockey, J[ohn] F[rederick], & McCurry, J[ohn] B[ruce]

Leaf curl and mosaic of the cultivated red raspberry. Phytopathology (Abstract) **12**: 58, 1922.

————, & ————

Mosaic and leaf curl of the cultivated red raspberry. Dom. Expt. Farm; Div. Bot. Circ. n.s. 1, 1922. (Phytopathology **12**(6): 253–264, 1922.)

Very complete description of these diseases which appear to be carried by *Aphis rubiphila.*

Raspberry mosaic and mosaic-free planting stock. N. Y. State Hort. Soc. Proc. **68**: 272–280, 1923.

This disease is the most important cause of low yields. The author gives descriptions, a discussion of methods of transmission, methods of control and other interesting data.

Running-out of raspberries. New York Agric. Expt. Sta. Circular **67**, 12 p., 1923.

This is attributed to mosaic, leaf curl and rosette.

Raspberry diseases. N. Y. Hort. Soc. Proc. 69: 139–145, 1924.
Popular.

Raspberry mosaic and blue stem. New York (Geneva) Agric. Expt. Sta. Circ. **75**, 4 p. 1924.
Popular.

Raspberry mosaic control in the Hudson River Valley. New York Hort. Soc. Ann. Meet. Proc. **71**: 173–178, 1926.
Popular.

Mosaic of raspberries New York (Geneva) Agric. Expt. Sta. Bull. **543**: 60 p., 1927.
The author describes the symptoms, gives results of roguing, rate of spread, varietal susceptibility and much other important data, including experimental proof that the important vectors are *Aphis rubiphila* and *Amphoraphora rubi.*

Mosaic of red and black cultivated raspberries. Phytopathology (Abstract) **17**(1): 46, 1927.

Probable identity of red and mild mosaic of black raspberries. Phytopathology (Abstract) **20**: 125–126, 1930.

Virus diseases of black raspberries New York (Geneva) Agric. Expt. Sta. Tech. Bull. **175**, 24 p., 1931.
The writer classifies the raspberries mosaic.

Raspberry mosaic control in the Hudson Valley, New York. Agric. Expt. Sta. Circ. **142**, 4 p. 1934.
Popular.

Rao, P. S.

The cause of spike in sandal (*Santalum Album.*) Indian Forester **46**: 469–487, 1920.
The disease may depend on sap density of the parent plant; therefore, an abnormal physiological reaction. Gives reason for his opinion.

Physiological anatomy of the spiked leaf in sandal. Indian Forester **47**: 351–360, 1921.
Gives a discussion of the structure and refers to the increase in starch, especially in the older leaves.

Rao, Rama

Field investigations of spike in sandal on the Kollimalai hills. Indian Forester **44**: 58–65, 1918.

Spike disease was found 80 miles from infested area. Observations on the ecological conditions are given with a list of 57 lots of sandal trees.

Rao, Y. V. S.

Contribution to the study of the spike-disease of Sandal (*Santalum album* Linn.) Part XIII. Investigations of the hexone bases. Part XIV Study of mosaics associated with mosaic areas. Journ. Indian Inst. Sci. **16A**(8): 91–95, 1933.

Report of analysis of healthy and diseased leaves of sandal as to nitrogen, amino acids, histidine and histamine contents.

Biochemical studies of *Gislkia* and *Ageratum* mosaics in relation to spike of sandal areas.

Rapson, C. J.

Control of streak disease in Uba Cane. Proc. 3rd Ann. Congr. South African Sugar Assoc. p. 10–12, 1925. (South African Sugar Journ. **Ann.** p. 154–157, 1925.)

Rathschlag, H.

Mosaik krankheit an der dahlia. (Dahlia mosaic disease.) Blumen N. Pflanzenb. **44**: 148, 149, 1929.

Mosaikkrankheit an salat. (Lettuce mosaic disease.) Obst. u. Gemüseb. u. **75**: 114, 115, 1929.

Ravn, F[rederik] K[olpin]

On mosaiksygen og beslaegtede Plantessygdomme. (Mosaic disease and allied plants diseases.) Nord Jordbrugrforsk **1**: 10–24, 1919.

Rawlins, T[homas] E[lsworth], & Johnson, James.

Cytological studies of the mosaic disease of tobacco. Amer. Journ. of Botany **12**(1): 19–32, 1925. (Phytopathology (Abstract) **14**(1): 55–56, 1924.)

A discussion of three types of bodies found in cells of mosaic plants.

Cytology of root tips from sugar beets having curly-top disease. Phytopathology (Abstract) **16**(10): 761, 1926.

Research on viruses causing plant diseases. Science n.s. **65** (1686): 398, 1927.

A very short paper on the nature of filterable viruses in which the author suggests several lines of research.

————————, & Horne, W[illiam] T[itus]

A graft infectious disease of the cherry. Phytopathology (Abstract) 20(10): 853, 1930.

————————, & ————————

"Buckskins", a destructive graft-infection disease of the cherry. Phytopathology 21(3): 331–335, 1931.

A disease of cherries in northern California which is transmitted by grafting.

Ray, J[ulien Charles Michel]

Sur les maladies de la canne á sucre. (The diseases of sugar cane.) Bull. Soc. Mycol. France 12(4): 139–143, 1896.

Read, W. H.

Physiological investigations of mosaic disease of the tomato. Expt., & Res. Sta. Cheshut Herts., 1931, Ann. Rpt., 17: 44, 1932.

A preliminary report indicates that total and reducing sugar rise for about 8 days and begin to fall after 20 days.

Physiological investigations of mosaic disease of the tomato. Expt. & Res. Sta. Cheshut Herts, 1932. Ann. Rpt., 18: 45–48, 1933.

Continuation of previous work.

Reddick, Donald, & Stewart, V[ern] B[ohnam]

Varieties of beans susceptible to mosaic. Phytopathology 8(10): 530–534, 1918.

The authors give the results of many tests which indicate that field selection of apparently healthy seed does not control the disease.

————————, & ————————

Transmission of the virus of bean mosaic in seed and observations of thermal death-point of seed and virus. Phytopathology, 9(10): 445–450, 1919.

The disease is transmitted by rubbing the leaves of young plants with crushed leaves from diseased plants but not by injecting. Dry heat range from 50 to 80° C. (1 to 24 hours) reduced germination but did not kill the virus.

————————, & ————————

Additional varieties of beans susceptible to mosaic. Phytopathology, 9(3): 149–152, 1919.

Gives the records of additional work.

A hybrid bean resistant to anthracnose and to mosaic. Phytopathology (Abstract) **12**(1): 47, 1922.

La transmisión du virus de la mosaïque du Haricot par le pollen. (The transmission of mosaic virus in Kidney beans by the pollen.) Second Cong. Inter. Path. Comp. (Paris) **1**: 363–366, 1931.

The mosaic disease of beans (*Phaseolus vulgaris*) is transmissible by pollen.

A potato disease. Phytopathology **23**(7): 622–624, 1933.

Brief note describing a disease which seems to be due to a virus.

Redpath, W. H.

A planter's experience with mosaic disease and the planting of Uba Cane. Journ. Jamaica Agric. Soc. **29**(1): 18–21, 1925. (Rev. Appl. Mycol. **4**: 442, 1925.)

Reed, H[oward] S[prague], & Craybill, C[harles] H[arvey]

Notes on plant diseases in Virginia observed in 1913 and 1914. Virginia Sta. Tech. Bull. **2**: 37–58, 1915.

Reesema, Geerts van, et al

Mosaic disease in Java. P. O. J. canes not immune. (A review of a technical article in Java.) Archief. **32**: 301–309. (Facts About Sugar **19**(21): 496, 1924.)

Reid, Katherine W[illess]

Variegated Abutilons. Journ. New York Bot. Garden **15**: 207–213, 1914.

A historical discussion.

Reiling, H.

Einige neuere Virus-Krankheitsformen. (A new virus disease form.) Deutsche Landw. Presse **55**(15): 219, 1928.

Beiträge zur kenntnis der Viruskrankheit der Kartoffel. (Contribution to the study of virus diseases of the potato.) Pflanzenbau **5**: 284–290, 1929.

Reincke, R.

Experimentaluntersuchungen über die Chlorose del gelben Lupine. (Experimental investigations about chlorosis of yellow lupin.) Dungg. Bodenkd. A. **23**: 77–104, 1931.

Reinking, Otto A[ugust]

A Disease of Economic Plants in Southern China. The Phil. Agricul. 8: 109–134, 1919.

A popular discussion.

Fiji disease of cane. Sugar Cent. and Planters' News. Philippine Is. 1(1): 15–20, 1920. (Facts About Sugar 12: 272–273, 1921.)

Diseases of sugar cane in the Philippines. Sugar Cent. and Planters' News, 1(2): 41–48, 56, (3)94–120, (8): 335–336, (14) 22–30, 35–39, 43, 1920, (15): 18–22, 2(5): 190–191, 1921.

Popular.

Fiji diseases of sugar cane. Sugar Cent. & Planters' News. 2 (2): 41–48, 1921.

Gives a description and states that the disease is very destructive. Some varieties are very resistant.

Fiji disease of sugar cane in the Philippine Islands. Phytopathology 11(8): 334–336, 1921.

Reitmair, Otto

(The leaf-roll disease of the potato.) Ztschr. Landw. Versuchws. Osterr., 13(1): 48–52, 1910.

Biologische Studien uber die Blattrollkrankheit der kartoffel. (Mitteilungen des Komitees zum Studium der Blattrollkrankheit der Kartoffel, No. 4). (Biological studies about the leaf-roll disease of potato. Report of the committee for the study of potato leaf-roll disease No. 4.) Zeitschrift fur des Landw. Versuchs. Oesterr., Jahrg. 15(1): 1–106, 1912.

(Report of the committee for study of leaf-roll—VII Biology of the potato plant with particular reference to leaf-roll.) (Ztsch. Landw. Ver. Ostrr., 16:(6)653–717, 1913.

Remy, L.

Mutation in mosaïque. (Mutation on mosaic.) Compt. Rend. Acad. Sci. Paris 187: 607–609, 1928.

Remy, Th[eodore] & Schneider, G[eorge]

Beobactilungen uber das auftreten der Blattrollkrankheit. Fuhlings Landswirts Zeitung, Jahrg. 58(6): 201–219, 1909.

Die mosaikkranheit der Kartoffel. (Mosaic disease of potato.) Veroffentl. Landw. Ammer Rheinprov. No. **2**: 93–95, 1919.

Reyes, G[audencio] M.

Mosaic disease of sugar cane. Philippine Agric. Rev. **20**(2): 187–228, 1927. (Rev. Appl. Mycol. **7**: 197, 1928. Facts About Sugar **23**: 34, 1928. U. S. D. A. Expt. Sta. Rec. Abs. **59**: 643, 1928.)

A history of the disease in the Philippine Islands with discussion of methods of control including a list of resistant varieties.

Reynolds, Ernest Shaw.

Two tomato diseases. Phytopathology **8**: 535–542, 1918.

Leaf chlorosis is regarded by the author as the so-called mosaic. Was unable to transfer it by rubbing; external application of iron salts failed. One of the diseases in this paper is a chlorosis which the author describes as a new virus disease.

Richards, B[ert] L[orin]

A new and destructive disease of the potato in Utah and its relation to the potato Psyllid. Potato Ass'n Amer. Proc. **14**: 94, 1928. (Phytopathology (Abstract) **18**(1): 140–141, 1928.)

Description of the disease and a report of its spread. Associated with the potato psyllid (*Paratrioza cockerelli*).

Botany and plant pathology in Utah. Utah Agric. Expt. Sta. Bull. **209**: 44–51, 1929.

Notes on leaf-roll and mosaic diseases of potatoes, psyllid yellows, mosaic and western blight of tomatoes.

Further studies with psyllid yellows of the potato Phytopathology (Abstract) **21**(1): 103, 1931.

---------, **& Blood, H[eber] L[oran]**

Psyllid yellows of the potato. Journ. of Agric. Res. **46**: (3): 189–216, 1933.

The authors give the history, description of this disease which is associated with *Paratrioza cockerelli*. In their summary they say: "The true nature of the infective principle injected into potato plant by *Paratrioza cockerelli* at present remains unknown. Available facts, however, question somewhat the virus theory of the disease and suggest the possible existence of some toxic substance which is produced in some way during the feeding process of the psyllid nymphs. Additional facts will be necessary before final conclusions can be drawn as to the true etiology of psyllid yellows."

Richardson Kuntz, P[edro Alejandro]

Estudios comparativos de las cañas Kavangire, Zuinga y Cayanna 10. Ins. Expt. Sta. Puerto Rico. Circ. **73**, 11 p., 1923.

Popular comparative descriptions of these varieties and reference to its tolerance to sugar-cane mosaic.

La producción de nuevas variedades de caña y sus resultados experimentales. (Sugar-cane varieties production and its experimental results.) Ins. Expt. Sta. Puerto Rico Bull. **28**, 67 p., 1931.

Popular information of data of experimental field tests of new varieties of sugar cane in regard to susceptibility and immunity to the mosaic disease.

El mosaico en las nuevas variedades de caña de azúcar P. R. 803: P. R. 807; F. C. 916 y S. C. 12(4). (Mosaic on the new sugar-cane varieties P. R. 803; P. R. 807; F. C. 916 and S. C. 12(4). Ins. Expt. Sta. Puerto Rico Circ. **96**, 10 p., 1932.

Field test to try the above-mentioned varieties in regard to mosaic immunity. P. R. 803 and F. C. 916 are highly tolerant, P. R. 807 commercial immune and S. C. 12(4) used as check highly susceptible. Results given in tabular form.

Resistencia relativa al matizado de cañas producidas en el país comparadas con las importadas. (The relative resistance to mosaic of native grown and imported canes.) Ins. Expt. Sta. Puerto Rico. Circ. **101**, 23 p., 1932.

Full details are given of the author's comparative observations on the relative productivity and resistance to mosaic of the locally produced and imported sugar-cane varieties in Puerto Rico. He reports that the Puerto Rico seedlings P. R. 803 and 807 and F. C. 916 were superior both in regard to yields and resistance to mosaic. Among the foreign, P. O. J. 2878 proved superior to B. H. 10(12) and S. C. 12(4) in both respects.

Cane varieties in Puerto Rico. Facts About Sugar **27**(12): 530–532, 1932.

The author emphatically states that mosaic is the only sugar-cane disease of real economic importance in Puerto Rico. He also assures that its control, to day, presents virtually no difficulty.

Ridler, W[inifred] F[rances] F[urze]

The structure of reverted black currants. Univ. Bristol Ann. Rpt. Agric. & Hort. Res. Sta. p. 73–74, 1923.

The diseased plants have less vascular tissue and more medullary ray tissue than the healthy plants. The diseased plants also produce a

gum which blocks the conducting tissues. The fruits from diseased plants contain less vascular tissues than those from healthy plants.

Investigation of the structure of reverted black currants. Ann. Appl. Biol. **11**(2) : 252–260, 1924.

The author states that no actual qualitative differences in structure have been observed between normal and reverted plants of black currants (*Ribes nigrum*). The most marked difference is in amount of gum and wood.

Rietsema, J.

Weinig bekende ziekten in kers, Pruim en Persik. (Little known diseases in Cherry, Plum and Peach.) Tijdschr over Plantenziekten **36**(11) : 261–266, 1930.

Cherry and plum virosis is sometimes associated with a form of mosaic.

Riha, J.

(Correlation coefficient for estimating the reduction in yields caused by the more important of our potato diseases.) Ochrana Rostlin, Prag. **8** : 58–61, 1928.

(Is the mosaic disease of potatoes as injurious as leaf roll?) Zemedesky Arch. Prag. **19**(3–4) : 134–140, 1928.

Rischkow, V[itolij] L. *

Neue Daten über geaderte Panaschierung bei *Evonymus japonicus und Evon radicans.* (New data on veined mottling in *Evonymus japonicus* and *E. radicans.*) Biol. Zentralbl. **47** (12) : 752–764, 1927. Rev. Appl. Mycol. **9**(3) : 195, 196, 1930.)

The chlorosis is transmitted by grafting but not by insects.

(Infectious chlorosis in *E. japonicus* and *E. radicans.*) Journ. All-Russ. Congr. Bot. Leningrad (Abstract) p. 184–185, 1928.

————————, **& Karatschewsky, I. K.**

Chlorophyllmangel und Erzymwirkung I. Katalasewirkung bei Panaschierung und Mosaikkrankheit. (Chlorophyll deficiency and enzymatic action I. Catalese action in variegation and mosaic diseases.) Beitr. Biol. der Pflanzen. **20**(3) : 199–220, 1933.

Extensive account well illustrated with tables. Gives also results with other variegated plants.

Rivas, Dámaso

Filterable Viruses Peculiar to Plants. Human Parasitology, p. 222–223, 1920.

* Also appears as Rizhkov, V. L.

Rivers, Thomas M.

Filterable viruses. A critical Review. Journ. Bact. **14**: 217–255, 1927.

The Nature of viruses. Physiol. Rev. **12**(3): 423–452, 1932.

Robb, W.

Scottish Society for Research in Plant Breeding. Report of the Director of Research to the Annual Meeting 13th July 1933, 32 p., 1933.

This report deals entirely on the behaviour of virus diseases of the potato plant with special reference on leaf-roll disease.

Robbins, Wilfred William

Mosaic disease of sugar beets Phytopathology (Abstract) **11** (1): 48, 1921.

Mosaic disease of sugar beets. Phytopathology **11**(9): 349–365, 1921.

Gives a description of a disease which is different from curly top. The disease is carried by *Mysus persicae*. It is carried over winter in the siloes.

Robertson, N. F.

Mycology. Report Dept Agric. Burma, **1927**, p. 11–12, 1927. (Rev. Appl. Mycol. **7**: 559, 1927.)

A brief reference to sugar-cane mosaic in three new localities.

Robertson, J. N., & Smith, A. M.

A study of the hydrogen-ion concentration of the potato tuber. Biochem. Journ. **25**(3): 763–769, 1931.

Rochlin, Emilia, J.

Zur anatomie der mosaikkranken kartoffel pflanzen. (On the anatomy of mosaic diseased potato plants.) Phytopath. Zeitschr. **2**(5): 455–468, 1930. (Materials for Mycol. & Phytopath., Leningrad. **8**(2): 145–154, 1931.)

These studies show structure changes in the phloem of leaf-roll, rugose mosaic, curly dwarf and stipple streak. Also some changes in the medullary and cortical tissue.

Rosa, Joseph Tooker

Chemical changes accompanying the western yellow blight of tomato. Plant Physiology **2**(1): 163–169, 1927.

The chemical changes in the tomato caused by this disease are different from those caused by the same virus (curly top) in sugar

Rosen, H[arry] R[oberts]

Mosaic disease of sweet potatoes. Arkansas Agric. Expt. Sta. Bull. **167**, 10 p., 1920.

Disease first recognized by the author in 1918. It is a hereditary but non-infectious chlorosis. Recommendations for control.

Corn mosaic in Arkansas. Phytopathology (Abstract) **12**(5): 250, 1922.

Mosaic disease of corn in Arkansas. Phytopathology (Abstract) **12**(5): 252, 1922.

Sweet potato mosaic and its incubation period of two growing seasons. Phytopathology (Abstract) **16**(1): 74, 1926.

The mosaic disease of sweet potatoes with special reference to transmissibility. Arkansas Agric. Expt. Sta. Bull. **213**, 16 p., 1926.

This paper gives the results of inoculation experiments which show that the disease develops very slowly. The conditions for its spread are much better in the southern than in the northern States.

Rosenfeld, A[rthur] H[inton]

Kavangerie: Puerto Rico mosaic disease-resisting cane. Int. Sugar Journ. **22**: 26–33, 1920.

Aspecto beneficioso del mosaico de la caña de azúcar. (Beneficial aspect of the sugar-cane mosaic disease.) Rev. Agric. Puerto Rico **12**: 7–14, 1924. (Int. Sugar Journ. **26**(304): 191–195, 1924.)

La causa del matizado. Un paso hacia la solución de este misterio. (The Cause of Mosaic. One step toward the solution of this mystery.) Rev. de Agricultura de Puerto Rico **13**(3): 145–148, 1924; (Int. Sugar Journ. **26**(310): 535–536; Facts About Sugar **19**(18): 425. Trop. Agric. **64**(1): 38–40, 1925.)

"The Java P. O. J. canes in Tucumán and Puerto Rico." Dept. Agric. Journ. Ins. Expt. Sta. Puerto Rico **8**(3): 1–44, 1925.

Selección de caña para la plantación. (Sugar-cane selection for the planting.) Sugar **28**(3): 153–155, 1926.

A monograph of sugar-cane varieties. Journal Dept. Agric., P. R. Vol. XI, 1927.
Contains some data on mosaic.

Lessons from the renaissance of a Sugar Industry. Int. Sugar Journ. **29**(348): 634–641, 1927. (Rev. Appl. Mycol. **7**: 400-401, 1927.)
The author discusses the relationship of mosaic to varieties.

Rosenthal, H.
Viruskrankheit bei schwarzen Johannisbeeren. (Virus disease of black currants.) Obst-und Gemüseban, **76**(1): 14, 1929. (Rev. Apply Mycol. **9**: 394, 1930.)
A brief note on the reversion of black currants in Holland.

Rouzinoff, P. G.
(Some data on the physiology of potato leaf-roll.) Morbi Plantarum, Leningrad **19**(3–4): 148–159, 1920.
The experiment discussed by the author was with the view to find a rapid laboratory method for determining the virus diseases in potato plants.

Roxas, M[anuel] L[uz]
Select your cane points for seed. Sugar Central & Plant News **1**: 16, 17, 1920.

Rozhdestvenskij, N. A.
(Virus diseases on potatoes and other plants.) Journ. All-Russ Congr. Bot. Leningrad (Abstract) p. 183, 1928.

Ruggles, Arthur Gordon, & Winter, J. D.
Aspects of mosaic of the red raspberry from the standpoint o the nursery inspector. Minnesota Hort. **54**: 79–85, 1926 (Journ. Econ. Ent. **19**(2): 365–370, 1926.)
Field observations and discussions.

Results of three years' experience in the control of mosaic in red raspberries in nurseries. Journ. Econ. Ent. **20**(3): 478-483, 1927.
The author gives the results of roguing experiments which led to the conclusion that the disease can be controlled in this manner.

Rusconi, A.
Osservazioni e considerazioni sulla clorosi del pesco nell. Albeiganese. La Costa Azzura Agr: Floreale, Sanremo **18**(9) 324–327, 1933.

Rutgers, A[braham] A[rnold] L[odewyk]

Die krulziekye van katjang tanah (*Arachis hypogaea.*) Meded. v. d. Afdeeing v. Plantenziekt. **6**: 1–5, 1913.

Salaman, R[edcliffe] N[athan]

Degeneration of potatoes. Int. Potato Conference Roy. Hort. Soc. Ann. Rpt. p. 79–90, 1921.

Believes that "running out" is not due to vegetatively propagation but to mosaic which has for years been known as "curl".

Potato seedling mosaic. Brit. Assoc. Adv. Sci Rpt. (Abstract) **91**: 493–494, 1923.

Degeneration of the potato. An urgent problem. Journ. Nation. Inst. Agric. Bot. **3**: 39–51, 1925.

A note on the production of premature sprouting in the potato and its application to the study of virus diseases. Journ. Agric. Sci. **17**(4): 524–529, 1927.

Gives the results of physiological experiments.

Virus diseases of the potato; Streak. Nature **126**(3172): 241, 1930.

The relationship of streaks to some other virus diseases.

Crinkle "A" an infectious disease of the potato. Proc. Roy. Soc. London ser. B. **106**(B741): 50–83, 1930. (Rev. Appl. Mycol. **9**: 603, 1930.)

The author describes this disease and gives proof that it is caused by a virus.

----------, **& Le Pelley, R[ichard] H[enry]**

"Para-crinkle": a potato disease of the virus group. Proc. Roy. Soc. London ser. B. **106**(13): 140–175, 1930.

The authors give the results of experiments on virus diseases, with special attention to "crinkle A."

Les maladies á virus de la pomme de terre. Leur analyse et leur synthése. (The virus disease of potato. Its analysis and its synthesis.) Second Inter. Cong. Comp. Path. Fac. Méd. Univ. Paris **1**: 451, 1931.

----------, **Bawden, F. C.**

An analysis of some necrotic diseases of the potato. Proc. Roy. Soc. London. ser. B. **111** (B769): 53–73, 1932.

The authors review the literature on streak disease of the potato They accept Quanjer acropetal necrosis as a symptom of stipple streal and of acronecrosis or top necrosis. They also discuss symptom produced by Kenneth M. Smith's X and Y viruses.

The analysis and synthesis of some diseases of the mosaic type the problem of carriers and auto-infection in the potato. Proc Roy. Soc. ser. B. **110**(B766): 186–224, 1932.

An extensive account describing in detail experiments in which th author has obtained evidence that, besides Smith's X and Y viruse there is a third element which he designates the Z virus. He mad cytological studies and summarizes recent developments.

Protective inoculation against a plant virus. Nature **131**(3309) 468, 1933.

Description of experiments carried by the author, on inoculation with plant viruses.

Salmon, E[rnest] S[tanley]

Fifth report on the trial of new varieties of hops 1921. Eas Malling Res. Sta. 1922.

Mosaic disease of hops. Journ. Min. Agric. **29**(10): 927–934 (Journ. Inst. Brewing **29**: 882–889, 1923.)

A discussion of this disease which is evidently due to a virus.

Sixth report on the trial of new varieties of hops. East Mallin Res. Sta., 1923.

A continuation of the proceedings.

Seventh report of the trial of new varieties of hops, 1923. Journ Inst. of Brewing **30**(8): 671–689, 1924.

Eighth report on the trial of new varieties of hops. East Mallin Res. Sta. p. 33, 1925.

---------, **& Ware, W[illiam] M[elville]**

Virus diseases and the grafting of the hop. Gard. Chron. se 3, **77**(2002): 320–322, 1925.

---------, **& Wormald, H.**

Diseases of the hop crop. Min. Agric. Misc. Publ. **42**: 41–5 1925.

Notes on a visit to the hop growing districts of Bohemia. Cze choslovakia Journ. Inst. of Brewing **31**(10): 514–521, 1925.

Eleventh report on the trial of new varieties of hops, 1926. East Malling Res. Stat. Kent. 34 p., 1927.

Notes on the ten new seedling varieties of hops used in the brewing experiments at Manchester, 1926. Journ. Inst. Brewing **33**: 570, 1927.

Notes on three varieties of hops. Journ. Inst. Brewing n. s. **33**: 12–14, 1927.

Tenth report on the trial of new varieties of hops. East Malling Res. Sta. p. 34, 1927.

----------, **& Ware, W[illiam] M[elville]**

The mosaic disease of the hop; grafting experiment I. Ann. Appl. Biol. **15**(3): 342–351, 1928.

The authors give the results of grafting experiments.

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Inter-specific grafting in Humules. Gard. Chron. ser. 3. **83**: 396, 1928.

Twelfth report on the trial of new varieties of hops, 1928. Journ. Inst. Brewing, n. s. **26**(11): 523–532, 1929. (Rev. Appl. Mycol. **9**(2): 130–131, 1930.)

A record of a severe outbreak of mosaic.

----------, **& Ware, W[illiam] M[elville]**

Report from the Mycological Department. Journ. South Eastern Agric. Coll. Wye., Kent., **26**: 165–172, 1929. (Rev. Appl. Mycol. **9**(1): 15, 1930.)

Brief reference to diseases of potatoes and hops that may be viruses.

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The chlorotic disease of the hop, I. Ann. Appl. Biol. **17**(2): 241–247, 1930.

The authors describe a new hop disease of the virus group and propose the names "Chlorotic disease" for its physical appearance. Two instances to record where the disease is transmitted artificially.

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The chlorotic disease of the hop, II. Ann. Appl. Biol. **19**(1): 6–15, 1932.

Continuation of previous work. Studies on transmissibility of this type of virus disease which is observed to be easily transmitted by grafting, budding and rubbing juice from infected plants on wounded

surfaces of healthy plants. This behaviour clearly distinguishes the chlorotic disease from the other two virus diseases of hops, i. g. mosaic and nettlehead, which up to the present are only transmitted by grafting.

The chlorotic disease of hop, **III.** Ann. Appl. Biol. **19**(4): 518–528, 1932.

This disease is transmitted by grafting. The authors give the results of experimental work.

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Mycological Department. Journ. South Eastern Agric. Coll., Wye, Kent. **29**: 15–22, 1932.

Samson, R[ayburn] W[alter]

A study of the properties and nature of the virus of the spindle tuber disease of potatoes. Unpublished Thesis Univ. Nebraska Library, 1927.

Relation of Jimson weed to certain viruses of tomato and potato. Phytopathology (Abstract) **20**(1): 136, 1930.

Samuel, G[eoffrey]

Nature of disease-producing viruses. Nature **125**(3141): 51, 1930. (Rev. Appl. Mycol. **9**: 397, 1930.)

------------., **Bald, J[ames] G[rieve], & Pittman, H[arold] A[mbrose Jaques]**

Investigations on "Spotted wilt" of tomatoes. Commonwealth of Australia Council for Sci. & Ind. Res. Bull. **44**, 64 p., 1930.

This paper gives a description of the disease, results of experiments on transmission and other host plants. The disease is carried by *Frankliniella insularis*.

Tomato diseases in South Australia and how to control them. Journ. Dept. Agric. South Australia **34**(2): 154–156; (3): 253–272; (4): 369–377; (5): 499–510, 1930.

Spotted wilt and streak on tomato is reported. Mosaic appears to be a glasshouse disease.

Summary of plant disease records in South Australia for the two years ending June 30th, 1930. Journ. Agric. South Australia **34**: 746, 1931.

Brief note on turnip mosaic.

---------, & -----------
Thrips tabaci as a vector of plant virus disease. Nature **128** (3229) : 494, 1931.

The authors confirm the work of Pittman and K. M. Smith that the spotted wilt of tomato is carried by *Thrips tabaci* but find that *Frankliniella insularis* can not transmit it, except in the larval stage.

Some experiments on inoculating methods with plant viruses, and on local lesions. Ann. Appl. Biol. **18**(4) : 494–507, 1931.

The author inoculated tobacco plants with cucumber mosaic and yellow tobacco mosaic by means of light rubbing without visible injury and by scratching with a needle. The former method was more successful than the latter. This supports the work of Holmes.

---------, **& Bald, J[ames] G[rieve]**
On the use of the primary lesions in quantitative work of two plant viruses. Ann. Appl. Biol. **20**(1) : 70–99, 1933.

The authors used the method devised by Holmes. They say, "Tomato spotted wilt forms necrotic primary lesions on the leaves of tobacco of a character suitable for quantitative work, and a number of the results obtained with tobacco mosaic have been checked with this virus." They discuss the method and results.

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Tomato spotted wilt of tomatoes. Journ. Dept. Agric. South Australia **37**(2) : 190–195, 1933.

A brief article, well illustrated describing South Australia tomato spotted wilt which is transmitted by *Frankliniella insularis* and *Thrips tabaci*. Control measures are recommended.

---------, -----------, **& Eardley, C. M.**
"Big bud" a virus disease of the tomato. Phytopathology **23** (8) : 641–653, 1933.

This disease was originally named "tomato rosette" by Cobb. The authors describe the abnormalities produced by the disease in tomatoes and state that it was not possible to transmit it by mechanical inoculation, but readily by budding and grafting. The shortest incubation period being 28 days. The insect vectors of the disease have not yet been discovered. It was found that *Solanum nigrum* showed similar symptoms to those of diseased tomato plants, but it was not possible to transmit it to tobacco or *Nicotiana glutinosa*.

The movement of tobacco mosaic virus within the plant. Ann. Appl. Biol. **21**(1) : 90–111, 1934.

A well illustrated work based on Holmes' studies on the subject.

Sandsten, E[mil] P[eter], & Tompkins C[hristian Milton]

Degeneration in Colorado potatoes. Colorado Agric. Expt. Sta. Bull. **278**: 3–15, 1922.

A popular discussion of losses.

Sartory, Gratiot, & Thiébant.

Sur le rajeunissement de la pomme de terre. (On the rejuvenence of the potato.) Comptes Rendus Acad. Sci. **158**: 45, 1914.

Sastri, B. N., Sreenivasaya, M., & Iyengar, J. V. V.

Contributions to the study of spike disease of sandal. (*Santalum album* Linn.) VII.—Factor influencing diastatic activity. VIII.—Chemical composition tissue fluids from the leaf. IX. —Chemical composition of tissue fluids from the stem. X. —Seasonal studies on healthy and partially spiked trees. Journ. Indian Inst. Sci. **12A**(17): 233–250. 295–305. 1929.

The diseased plants have a higher diastatic activity than the healthy plants.

Note on the starch-liquefying action of Sandal leaf extracts. Indian Inst Sci. **12A**: 251–252, 1929. (Rev. Appl. Mycol. **9** 277, 1930.)

The studies on the spike disease suggested that the accumulation of starch in the leaves was caused by failure to liquefy. Studies on hydrolysis of potato starch by extracts from healthy and diseased leaves showed that more starch liquefied in the healthy than in the diseased leaves.

————, & Narayana, M.

The spike disease of *Dodonaea viscosa*. Journ. Inst. Indian Sci **13A**(12): 147–152, 1931.

Results are given and discussed as to the constituents of health and diseased plants.

Saunders, A[braham] R[amie]

Some aspects of the virus disease problem in plants. Sout African Journal Sci. **23**: 295–304, 1926.

Sauri, F.

El mosaico de la caña de azúcar. (Sugar cane mosaic.) Rev Agric. Rep. Dominicana. **18**(6): 101–104, 1923.

Popular.

Durch welche Mitted treten wir der Blattrollkrankheit un ähnlichen Kartoffelkrankheiten entgegen? (Through whic

means do we treat against leafroll and similar diseases?) Fühlings Landw. Zeitg. 1916.

Savastano, Giulio

Il mosaico del Fagiolo in Italia. (Bean mosaic in Italy.) Boll. R. Staz. Pat. Veg n. s. **12**(4): 377–394, 1932.

The author accounts for the symptoms, distribution, probable nature, and types of bean mosaic. Gives methods of control.

Sayer, Wynne.

Mosaic and its control in other cane growing countries. Agric. Journ. of India. **24**(1): 25–31, 1929. (Facts About Sugar 24: 371, 1929. Rev. Appl. Mycol. 8: 404, 1929.)

An exposition of data and facts for every country.

Schaffnit, J[ohannes Martin] E[rnst Christian Otto]

Zur erforschung der Mosaikkrankheiten. (Investigation of mosaic disease) Angew. Botanik. **8**(5): 304–313, 1926.

The author gives a general discussion and expresses the opinion that the "running out" of potatoes is due to environment and not to virus diseases.

Panaschierung und Mosaikkrankheit. (Variegation and the mosaic disease.) Forsch. Gebiet Pflanzenkr. u Immunitat in Pflanzenreich **1**(4): 16–22, 1927.

The author criticizes the classification of Küster and Sorauer. He claims that variegations are transmitted through the germ plasm; that mosaic diseases have symptoms other than mottling.

----------, **& Weber, H[ermann]**

Über das Vorkommen von intrezellularen Körpern in den Geweben mosaikkranker Rüben. (Occurrence of intracellular bodies in the tissues of mosaic-diseased beets.) Forsch. Gebiet Pflanzenkr. u. Immunitat Pflanzer. **1**(4): 23–42, 1927.

The author describes intracellular bodies found in the phloem of mosaic beets. These bodies were not found in healthy beets.

Ueber die wechselseitize ueber tragbarkeit des Mosaikkrankheit von Rübe und Spinat. (On the intertransmissibility of the mosaic, disease of beet and spinach.) Centrabl. Für Bakt. Abt. II, **71**: 490–497, 1927. (Rev. Appl. Mycol. 7: 136, 1927.)

The disease of these two plants are the same or closely related. They are transmitted by *Aphis fabae* (*A. rumicis*) and *Macrosiphum*.

Der gegewartige Stand der Forschung über Viruskrankheit. (Present status of research on virus diseases.) Beiträge z. Pflanzenzucht. **9**: 25–41, 1927, (Pflanzenbau **4**: 9–10, 1927–28.)

————————, & **Lüdtke, M.**
Untersuchungen über Viruskrankheiten. 9. Beiträge zur kenntnis des stoffwechsels mosaikkranker und gesunder Tabakpflanzen. (Investigations about the virus diseases. 9. Contribution to the study of assimilation in mosaic diseased and healthy tobacco plants.) Phytopath. Zeitschr. **2**: 341–359, 1930.

On the differentiation and transmission of virus diseases of the *Solanaceae* and the dependence of their occurrence and spread on the nutrition of the plants. Fifth Intern. Bot. Congr. Cambridge **1930**: 380–382, 1930.

————————, & **Muller, W.**
Untersuchugen über Viruskrankheit (10 Mitteilung). Wechselseitge Virusü-ber-tragungen innerhalb des Famile der Solanaceen. (Investigations on virus diseases (Note 10). Reciprocal virus transmission within the family of the Solanaceae.) Phytopath. Zeitschr. **3**(2): 105–136, 1931.

A very extensive and detailed discussion on the subject.

————————, & **Johnssen, A.**
Untersuchungen über Viruskrankheiten (II Mitteilung). Beiträge zur kenntnis der Blattrollkrankheit der Kartoffel. (Studies on virus diseases. (Note II). Contributions to the knowledge of the potato leaf-roll disease.) Phytopath. Zeitschr. **5**(6): 603–612, 1933.

The author describes the successful results obtained in his experiments in the transmission of leaf roll disease by means of the aphids *Myzus persicae* and by grafting.

Schander, R[ichard]
(Potato diseases.) Fuhling's Landw. Ztg. **58**(8): 273–285, 1909.

(New studies on the leaf-roll disease of the potato.) Jahresber ver. Angew Bot. **7**: 235–245, 1909.

(The leaf-roll disease of the potato.) Ber. West Preuss. Bot. Zool. ver. **32**: 70–72, 1910.

(Leaf-roll of potatoes and related diseases.) Fuhling's Landw. Ztg. 63(7): 225–243, 1914.

————————, & **Tiesenhausen, M[anfred]**
Kann maw die Phloemnecrose als Ursache oder Symptom der Blattroll Krankheit der Kartoffel ansehen. (Phloem necrosis

as cause or symptom of leaf-roll of potato.) Mitt Kaiser Wilhelms Inst. Landw. Bromberg **6**(2) : 115–124, 1914.

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Untersuchugen über das Verhältnis der keimfähigheit der Kartoffelknollen zum Gesundheitszustand und Ertrag. (Investigations on the relations of the germination activity of potato tubers to healthiness and yield.) Centralbl. für Bakt., Abt. 2, **60**(1–6) : 27–80, 1923.

Zur Mosaikkrankheit der Kartoffel. (Mosaic disease of potato.) D. Kartoffel **5** : 212–213, 1925.

Neuere Arbeiten über die Blattrollkrankheit. (New work on the potato leaf-roll.) Mitt. der D. L. G. **42**(23) : 613–615, 1927.

Physiologische Untersuchungen an Blattrollkrankheiten Kartoffel. (Physiological investigation on potato leaf-roll disease.) Landw. Versuchs-Stationnen **55**(3–4) : 198–204, 1927.

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Nekrose und andere Degeneration serscheinungen im Phloem der Kartoffelpflanzen (Necrosis and other degeneration phenomena in the phloem of potato plants.) Arb. Biol. Reichsanst. Land u. Fortwirtsch. **15**(5) · 609–672, 1928.

The author discusses necrosis which is a pathological condition; and necrobiosis and obliteration which are due to old age.

Schek, A.

Ueber de Kräuselkheit der Kartoffeln. (On the curl disease of potatoes) D. Landw. Presse **2** : 666, 1875.

Historical.

Scherffius, W[illiam] H[enry]

Tobacco mosaic. Some interesting experiments on a supposed disease in Turkish tobacco. *Journ. Dept. Agric. South Africa, **8**(1) : 33–34, 1924.

The author claims that certain green splotches in cured tobacco are not caused primarily by mosaic.

Schertz, F[rank] M[ilton]

A chemical and physiological study of mottling of leaves. Bot. Gaz. **71** : 81–130, 1921.

This is not a study on virus diseases, but is of interest to students of the subject.

Schewe, O.

Der einfluss der kalidüngung auf die Blattrollkrankheit der kartoffel. (The influence of potash fertilization on the leaf-roll disease of potato.) Ernahr. d. Pflanze **19**: 121–122, 1923.

Schleh

Ein Beitrag zur Kenntnis der Blattrollkrankheit der Kartoffeln (A contribution to the study of the leaf roll disease of potatoes.) Fühlings Land. Zeit. **58**: 641–663, 1909.

Schlumger, O[tto]

Beobachtungen und Erfahrungen über den Gesundheitszustand der Kartoffel in Fahre 1930. (Observations and experiences in connection with the state of health of potatoes in the year 1930.) Pflanzenbau **7**(4): 118–119, 1930.

Roguing is recommended by the author to prevent spread of mosaic in the field from plant to plant.

Schmid, A.

Zur Vererbung der Blattrollkrankheit der kartoffel. (Inheritance of leaf-roll disease of potatoes.) Illus. Landw. Ztg., **31** (17): 160, 1911. (Abs Centbl. Bat. Abt. **31**: 331–332, 1911.)

Schmidt, A.

Die Kräuselkrankheit der Pelargonien. (The curl disease of Pelargonium) Gärtner-Börse **13**: 1–308, 1931.

Schmidt, E[rnst] W[illy]

(A discussion of the leaf-roll disease of the potato.) Dent. Landw. Presse. **36**(99): 1051, 1909.

Zur Mosaikkrankheit der Zuckerrübe. (Mosaic disease of sugar beet.) Ber. Deutsch. Bot. Ges. **45**(9): 598–601, 1927.

A discussion of the significance of crystals in the roots of mosaic beets.

Zur Mossaikkrankheit der Zucker-und Futterübe. (Mosaic disease of sugar and fodder beets.) Deut. Zuckerid. **52**: 1305–1306, 1927.

The author reports a mosaic disease of sugar beet in Germany.

Scholz, W.

Bisherige forschungsergebuiss betreffend die chlorose der gelben lupina (*Lupinus luteus*) in ibren beziechung zum eizen. (Vorlaufige voroffenlichung.) (Results so far obtained from researches connected with chlorosis of thê yellow Lupin (*Lupinus*

luteus) in its relation to iron. (Preliminary publication.) Zeitschr. fur Pflanzen. Dungung & Bodenkunde. **A. 25**: 287–293, 1932.

A summarization of previous work and its announcement of work in progress.

Schribane

Recherches sur l' enroulement de fescilles de la Pomme de terre. (Researches on the leaf-roll of potato.) Comptes Rendus Acad. Agr. France **5**(10): 356–358, 1919.

Schribau, Emile

Sur la dégénérescence des pommes de terre. (Potato degeneration.) Acad. Ag. France Compt. Rend **8**: 397–398, 1922.

Sur la dégénérescence de la pomme de terre et sur les moyens de la conjurer. (The degeneration of the potato and the means of preventing it.) Comp. Rendus. Acad. Agr. de France, **9** (3): 95–97, 1923.

Schultz, E[dwin] W[illiam]

The ultrascopic viruses from the biological standpoint. Sci. Mo. **31**: 422–443, Nov. 1930.

A general discussion dealing mostly with virus diseases of animals.

Schultz, Eugene S[chultz], Folsom, D[onald], Hildebrandt, F[rank] M[errill], & Hawkins, L[on] A[drian]

Investigations on the mosaic disease of the Irish potato. Journ. Agr. Res. **17**(6): 247–273, 1919.

This paper gives a discussion of distribution, losses, symptoms and methods of transmission. The disease can be transmitted in tubers, by grafting and by *Myzus persicae* and *Macrosiphum solanifolii*. The leaves from diseased plants contain more sugar and less starch than the leaves from healthy plants. Tubers from diseased plants may produce plants without symptoms. Hill selection does not give satisfactory results. Roguing before the coming of the insect vectors is efficient.

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Transmission of the mosaic disease of Irish potatoes. Journ. Agr. Res. **19**(7): 315–338, 1920.

Gives results of experiments showing that the disease can be transmitted by tubers, grafting, plant juice and aphids.

A transmissible mosaic disease of Chinese cabbage, mustard and turnips. Journ. of Agric. Res. **22**(3): 173–179, 1921.

Symptoms and transmission experiments.

————————, & Folsom D[onald]

Leaf-roll, net-necrosis, and spindling-sprout of the Irish potato. Journ. Agr. Res. **21**(1): 47–80, 1921.

Gives the results of studies, mostly on transmission which is by aphids.

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Transmission of potato streak. Phytopathology (Abstract) **12** (1) · 41, 1922.

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A spindling-tuber disease of Irish potatoes Science n. s. **57**: 149, 1923.

Proofs by transmission that this is a virus disease.

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"Spindling" tuber and other degeneration diseases of Irish potatoes. Phytopathology (Abstract) **13**(1): 40, 1923.

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Transmission, variation and control of certain degeneration diseases of Irish potatoes. Journ. Agr Res. **25**(2): 43–118, 1923.

Gives the results of extensive studies of the virus diseases of potatoes with special attention to their transmission from diseased to healthy plants and methods of control.

Why potatoes run out. U. S. D. Agr. Farmers' Bull. **1436**, 21 p., 1924.

A popular discussion.

————————, & Folsom, Donald

Infection and dissemination experiments with degeneration diseases of potatoes. Observations in 1923. Journ. Agr. Res. **30**(6): 493–528, 1925.

A description of symptoms including second generation reactions. Also extensive experiments on methods of transmission.

A potato necrosis resulting from cross-inoculation between apparently healthy potato plants. Science n.s. **62**(1616): 571–572, 1925.

The content of this paper is indicated by the title. The author thinks that the apparently healthy potatoes may have been symptomless carriers.

Potato diseases Potato Assoc. Amer. Proc. **15**: 293–296, 1928.

Popular.

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Apical leaf-roll of potato. Phytopathology (Abstract) **19**(1): 82, 83, 1929.

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Recent potato virus-disease information contributing to the production of better seed potatoes. Proc. Ann. Meeting Potato Assoc. Amer. **15**: 203–226, 1929. (Maine Agric. Expt. Sta. Bull. **353**: 147, 1929.)

A popular discussion.

Potato virus diseases. Proc. Ann. Meeting Potato Assoc. Amer. **15**: 293–295, 1929.

A popular discussion.

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Resistance of potato to latent mosaic. Phytopathology (Abstract) **23**(1): 32, 1933.

Report of results obtained with inoculations of latent mosaic which is generally present in a masked form in Green Mountain and other potato varieties.

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New necrotic virus disease of potatoes. Phytopathology (Abstract) **23**(1): 32, 1933.

Comparisons of this new virus disease with other types. Transferable to tomato, tobacco and *Datura stramonium*.

-------------, **Bonde, Reiner, & Raleigh, W. P.**

Components of potato mild mosaic Phytopathology (Abstract) **24**(1): 17, 1934.

-------------, **Clark, C. F., Bonde, Reiner, Raleigh, W. P., & Stevenson, F. J.**

Resistance of potato to mosaic and other virus diseases. Phytopathology **24**(2): 116–132, 1934.

A thorough account of the authors based on experimental observations on varietal resistance.

Schultz, G.

Entartung der Magnum bonum-Kartoffel? Deut. Landw. Presse **32**: 872–875, 1905.

Schwartz, M[arie] B[eatrice]

Eenige ziekten van onbekenden aard bij groenhemesters. (English Summary.) Inst. Plantenziekten. Korte. Meded. **5**, 19 p., 1927.

Schwarze, Carl Aloise

Relation of the mosaic of the pepper and the filiform leaf of the tomato to the mosaic of the tobacco. Phytopathology (Abstract) **4**(1): 42, 1914.

Schweiner, J.

Over virusziekten bij tabak. (On the virus diseases of tobacco.) Verlag Negende Vergadering V.V.P.P. p. 81, 1928.

Schweizer, G[eorge]

Zur Blattrollkrankheit der Kartoffelpflanze. (Leaf-roll disease of the potato plant) Ber. Deutsch. Bot. Ges. **44**(9): 551–561, 1926.

Physiological and chemical studies which show that there was more diastase in diseased than in healthy plants.

Ein Beitrag zur Atiologie und Therapie der Blattrollkrankheit bei der kartoffelplanze. (A contribution to the etiology and cure of the leaf-roll disease of the potato plant. Phytopath. Zeitschr. **2**(6): 557–591, 1930.

An extensive discussion on the etiology studies made by the author, giving as a promising controll method, the application to the soil of a mixture of manganese, lime, cyamide and uranium salts.

Schwing, E[dward] A., & Hartung W[illiam] J[ohn]

Utilization of systematic observations on beet leafhopper (*Eutettix tenella* Baker) and curly leaf of sugar beet. Journ. Econ. Ent. **15**(5): 365–368, 1922.

Notes on *Eutettix tenella* (Baker) in Northern California. Journ. Econ. Ent. **20**: 645–646, 1927.

A record of the overwintering of the insect.

Experiments on control of *Eutettix tenellus* (Baker). Journ. Econ. Ent. **27**: 790–791, 1928.

A brief paper giving methods and results.

Sein, Jr., F[rancisco]

Sugar-cane mosaic and other grasses. Ins. Expt. Sta. Report of the Div. of Entomology, Puerto Rico, Rpt. **1923–24**: 114, 1924.

Report of experiments in progress in relation to mosaic transmission using different aphid species.

A new mechanical method for artificially transmitting sugar-cane mosaic. Journ. Dept. Agric. Puerto Rico **14**(2): 49–68, 1930.

The author describes a new method in which he uses very fine insect pins. The spindle of a diseased plant is removed and placed in close contact with the spindle of a healthy plant. The pins are pushed through the diseased and into the healthy plant. The author reports a high percentage of infection.

Artificial transmission and other studies on sugar-cane mosaic. Fourth Cong. Intern't. Soc. Sugar-Cane Technologists, Puerto Rico, 1932, Bull. **84**, 6 p, 1933.

The author discusses the subject under widely different points of view. Some of them towards the nature of the virus and others dealing with its mechanical and insect transmission. *Aphis maidis* is conclusively a carrier of the disease; *Sipha flava* Forbes is not.

Selby, A[ugustine] D[awson]

Peach yellows, black rot and San José scale. Ohio Expt. Sta. Bull. **72**: 193–220, 1896.

A brief discussion of symptoms, cause, spread and treatment.

Investigations of plant disease in the forcing house and garden. Ohio Agric. Expt. Sta. Bull. **73**: 221–246, 1896.

Preliminary report on diseases of the peach. 1.—peach yellows. Ohio Agric. Expt. Sta. Bull. **92**: 190–199, 1898.

Report of committee on vegetable pathology. A peculiar malady of forced cucumbers. Ohio State Hort. Soc. Ann. Rept. **1902**: 109, 1903.

Popular. Early record.

Tobacco diseases and tobacco breeding. Ohio Agric. Expt. Sta. Bull. **156**: 88–94, 1904.

Describes diseases and reviews work of others. Proves transmission by touching diseased and then healthy plants. Gives percentages of transmission by this method. Not transmitted by the seed.

Mosaic disease of cucumber. Ohio Agric. Expt. Sta. Bull. **214**: 394, 1910.

Early record of this disease. The author believes it was due to an oxidizing ferment in the leaves. Compares it with tobacco mosaic and peach yellows.

Semple, D[avid] M[c Hardy]

Mosaic diseases cause heavy losses. Sugar Centr. & Planters' News, Philippines. **4**: 140, 1923.

Popular. Estimation of losses.

Serrano, F[elicisimo] B.

Banana diseases in the Philippines. Bureau of Agric. Philippine Is. Circ. **176**, 1925. (Philippine Agric. Rev. **18**(4): 578–582, 1925.)

Brief discussion of bunchy top disease on page 58.

Soubert, Elisabeth

Uber Keimschadigungen der Erstling durch Virus-Netnekrose. D. Kartoffel **7**: 131–132, 1927.

Severin, H[enry] H[erman] P[aul]

Investigations of the beet leafhopper *Eutettix tenella* (Baker). Journ. Econ. Ent. **12**: 312–326, 1919.

The author discusses the hibernation of the insect and the plants from which it carries the curly top to the beets. Gives the results of experiments with the insect and list of host plants for the virus.

The beet leaf-hopper. A report on investigations into its occurrence in California. Facts About Sugar **8**(7): 130, 131, 134. (8): 150, 151. (9): 170, 171, 173. (10): 190, 191. (11): 210, 211. (12): 230, 231. (13): 250, 255, 1919

Minimum incubation periods of causative agent of curly-leaf in beet leaf-hopper and sugar-beet. Phytopathology **11**(10): 424–429, 1921.

Experiment with a dusting machine to control the beet leafhopper *Eutettix tenella* (Baker) with nicotine dust. Journ. Econ. Ent. **14**: 405–410, 1921.

Practical use of curly leaf symptoms. Facts About Sugar **12**: 170–173, 212–214, 217, 1921.

Popular.

Minimum incubation period of causative agent of curly leaf in beet leaf hopper (*Eutettix tenella*, Baker) and sugar beet. Phytopathology (Abstract) **12**: 105, 1922.

Curly-top transmission experiments with beet leaf-hopper. Journ. Econ. Ent. **15**: 182, 1922.

The author gives evidence that incubation of the active agent is necessary. He says—"The minimum incubation period of the infective principle of curly leaf in the beet leafhopper required four hours at the following temperatures: maximum 103° F.; minimum

94° F. and mean 100° F. and three days in the sugar beet at the following temperatures: maximum 100° F., minimum 57.7° and mean 80.3° F.''

----------, & **Basinger, A. J.**

Facts concerning migration of beet leaf-hopper *Eutettix tenella* (Baker) in Sacramento Valley of California. Journ. Econ. Ent. **15**: 404–411, 1922.

This paper is important because the insect is the carrier of the virus of the curly top of the sugar beet.

Facts concerning natural breeding area of beet leaf-hopper *Eutettix tenella* (Baker) in San Joaquín Valley of California. Journ. Econ. Ent. **15**: 411–420, 1922.

This paper is important because the insect is the carrier of the curly-top of the sugar beet.

Control of the Leaf-hopper. Facts About Sugar **14**: 312–313, 332–333, 1922.

The author gives suggestions for the control of the insects.

The life history of the beet leafhopper. Facts About Sugar **14**: 92–93, 119–121, 130–131, 152–154, 158, 170–171, 1922.

Life history.

Control of the beet leafhopper. Facts About Sugar **15**: 134–135, 137. 1922.

The insects were checked by dusting with nicotine compounds and the amount of curly top reduced.

------------, **Hartung, W[illiam] J[ohn], Schwing E[dward], A., & Thomas, W[illiam W.]**

Investigations of beet leafhopper *Eutettix tenella* (Baker) in Salinas Valley of California. Journ. Econ. Ent. **16**(6): 479–485, 1923.

Incubation period. California Agric Expt. Sta. Ann. Rept. **1922–23**: 127, 1923.

Curly leaf transmission experiments. Phytopathology (Abstract) **14**(2): 123, 1924.

Curly leaf transmission experiments. Phytopathology **14**(2): 80–93, 1924.

A small amount of injections resulted from putting small drops of juice on leaves. The disease is carried by leaf hoppers. The active agent travels about 7 inches in about 30 minutes at a temperature of 103.5 degrees F.

Causes of fluctuation in number of beet leafhoppers *Eutettix tenella* (Baker) in a natural breeding area of the San Joaquín Valley in California. Journ. Econ. Ent. **17**: 639–645, 1924.

This paper is important because the insect is the carrier of the virus causing the curly top of the sugar beet.

A natural breeding area of the beet leaf hopper (*Eutettix tenella,* Baker.) in the Sierra Nevada mountains. Journal Econ. Ent. **18**(5): 730–733, 1925.

Percentage of curly-top infection in beet leafhopper *Eutettix tenella* (Baker) and winter host plants under field conditions. Journ. Econ. Ent. **18**(5): 733–737, 1925.

A record which is of importance in connection with the study of the curly top of sugar beets.

The 1925 outbreak of the beet leafhopper *Eutettix tenella* (Baker) in California. Journ. Econ. Ent. **19**: 478–483, 1926.

Crops naturally infected with sugar beet curly-top. Science n. s. **66**(1701): 137–138, 1927.

This is a brief paper giving a list of crops naturally infected with the curly top.

Notes on curly-top. Facts About Sugar. **22**(35): 844, 1927.

As a result of inoculation experiments the author gives a lengthy list of susceptible plants.

———, & Severin, Harry C[harles]

Curly-top of sugar beets in South Dakota. Journ. Econ. Ent. **20**(4): 586–588, 1927.

A report of the occurrence of the disease at this place. The insect vectors could not be found.

———, & Henderson, C[harles] F.

Beet leafhopper *Eutettix Tenellus* (Baker) does not occur in the Argentine Republic. Journ. Econ. Ent. **21**: 542–544, 1928.

A history of the records and claims.

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Some host plants of curly-top. Hilgardia 3(13): 339–392, 1928.
The authors discuss the flights of the leaf hoppers, give symptoms and valuable lists of host plants.

----------, & Swezy, Olive
Filtration experiments on curly top of sugar beets. Phytopathology 18(8): 681–690, 1928.
The author gives the results of feeding the leafhopper on filtered virus. These insects were able to transmit the disease but the juice became inactive on exposure to air.

Transmission of tomato yellows, or curly top of the sugar beet by *Eutettix tenellus* (Baker) Hilgardia 3(10): 251–274, 1928. (Phytopathology 18: 709–710, 1928.)
The author discusses the nature of the injury, symptomatology, life history of the insect carrier, inoculation experiments and some economic features of the disease.

Curly top symptoms on the sugar beet. California Agric. Expt. Sta. Bull. 465, 35 p., 1929.
A very thorough and well illustrated paper on symptoms.

Yellows disease of celery, lettuce, and other plants. transmitted by *Cicadula sexnotata* (Fall). Hilgardia 3(18): 543–582, 1929.
The disease is transmitted by *Cicadula sexnotata* (Fall). It is identical with aster yellows and with lettuce yellows. The disease also attacks several other plants.

Additional host plants of curly top. Hilgardia 3(20): 595–636, 1929.
The author gives records concerning newly discovered carriers of the virus of curly top.

Carrot and parsley yellows transmitted by the six-spotted leafhopper, *Cicadulla sexnotata* (Fall). Phytopathology 20(11): 920–921, 1930.
Parsley and carrots were successfully reciprocally and cross-inoculated.

Modes of curly top transmission by the beet leaf-hopper, (*Eutettix tenellus* (Baker). Higardia 6(8): 253–276, 1931.
The author gives much valuable data. The disease has been transmitted by 40 insects in as short a time as 20 minutes. The author

gives the results of extensive experimental work on this subject. The percentage of infected plants varied with the time the insects were allowed to feed on the plant and the number of insects used. The author gives tables and an excellent summary of the work.

Transmission of carrot, parsley and parsnip yellows by *Cicadulla divisa*. Hilgardia 7(3): 163–179, 1932

The author gives the symptoms, the disease and the results of experiments. The disease was transmitted back and forth among these three hosts and from the hosts to asters, celery and dock.

----------, & **Freitag, Julius H.**

Some properties of the curly-top virus. Hilgardia **8**(1): 1–48, 1933.

Results of studies made by the author in regard to curly-top virus, its properties, nature, inactivation, physical properties and other valuable data.

Field observations on the beet leafhopper *Eutettix tenellus* (Baker) in California. Hilgaria **7**: 281–350, 1933.

This paper gives a large amount of data concerning this insect which is the carrier of the curly top of the sugar beet.

-------------, & **Freitag, Julius H.**

List of ornamental flowering plants naturally infected with curly top or yellows diseases in California. U.S.D.A. Plant Disease Reporter **17**(1): 1–2, 1933.

Shaposhnikov, J. J.

(Russian beet variety resistant to curly top.) Sovietskii Sakhar. **1929**: 570–571, 1929; (Facts About Sugar (Abstracts) **25**(9): 216, 1930; Rev. Appl. Mycol. **9**: 425, 1930.)

The seed of variety P–19, which was produced in California was sent to its original home in Ivanovka, Russia. The seed from this crop was returned to California and grown. It was found to be resistant to curly top but the sugar content was less than the checks. The loss in sugar content was compensated by the resistance to the disease.

Shapovalov, M[ichael]

Effect of environmental conditions on western yellow blight of tomatoes. Phytopathology (Abstract) 14(2): 120, 1924.

The significance of the 1924 outbreak of western yellow tomato blight in the United States. Phytopathology (Abstract) 15: 50, 1925.

High evaporation: a precusor and a concomitant of western yellow blight. Phytopathology **15**: 220–278; 470–478, 1925.

A study of the relationship of environmental factors to the development of this disease.

Ecological aspects of a pathological problem (Western yellow blight of tomatoes.) Ecology **6**: 241–259, 1925.

----------, **& Beecher, F. Sidney**

Menace of western yellow tomato blight. Pacific Rural Press. **111**: 365–371, 1926.

The A.A.A.S. The Reno meeting of the Pacific division 11 American Phytopathological Society. Pacific Division. Science (Abstract) **66**: 247, 1927.

Inoculation experiments with western yellow tomato blight in relation to environmental conditions. Phytopathology (Abstract) **17**(10): 746, 1927.

Yellows, a serious disease of tomatoes. U.S.D.A. Misc. Pub. **13**: 2–4, 1928.

A brief review of our knowledge of the subject.

----------, **& Beecher, F. Sidney**

The development of tomato yellows under different light conditions. Phytopathology (Abstract) **18**(11): 950, 1928.

Tuber transmission of psyllid yellows in California. Phytopathology (Abstract) **19**(12): 1140, 1929.

----------, **& Beecher, F. Sidney**

Experiments on the control of tomato yellows. U.S.D.A. Tech. Bull. **189**, 1930.

The virus of this disease is the same as the virus of curly top of sugar beets and is carried by the leafhopper *Eutettix tenellus* Baker. The authors review the subject and give the results of experimental work. The disease is reduced by shading but dusting and spraying for the control of the insects gave encouraging results.

A celluloid cell for inoculation of plants with insect vectors. Phytopathology **20**(8): 681–683, 1930.

Illustration and description of this apparatus is of interest to students of inoculation of plant viruses.

------------, & **Jones, Henry A.**

Changes in the composition of the tomato plant accompanying different stages of yellows. Plant Physiol. **5**(1): 157–165, 1930.

The authors report the following changes:

1.—The increase of dry matter and the accumulation of starch and sugars appeared to be constant and should be regarded as a condition characteristic of this virus disease.

2.—Changes in the amount of nitrogen is variable.

3.—The carbohydrate accumulation in the same plant is progressive. Other valuable data is given.

------------, & **Lesley, J[ames] W[yvill]**

Effect of shading on the rate of development of tomato yellows. Phytopathology **21**(1): 83–87, 1931.

Shading increases the tolerance of the plant to the virus provided that partial protection from beet leafhopper (*Eutettix tenella* Baker) is afforded. If continued after infection a crop is produced and in some cases recovery from the disease occurs.

The growth rate of tomato plants affected by yellows. Phytopathology (Abstract) **21**(1): 106, 1931.

Graft transmission of curly top in tomatoes (tomato yellows). Phytopathology (Abstract) **21**(10): 998–999, 1931.

The dieback form of tomato streak. Phytopathology (Abstract) **23**(11): 928, 1933.

Shaw, Harry B[erry]

The curly top of beets. U.S.D.A. Br. Plant. Indus. Bull **181**, 46 p., 1910.

Describes the symptoms and gives the results of experiments to determine the cause. Also discusses the leafhopper *Eutettix tenella* (Baker) in relation to the disease and to some of its other host plants.

Shear, C[ornelius] L[ott]

Cranberry diseases in Wisconsin. Wisconsin State Cranberry Growers' Assoc. Ann. Rept. **21**: 17–21, 1908.

Early record.

False blossom of the cultivated cranberry. U.S.D.A. Bull. **444**, 1916.

A general discussion of the disease, the cause of which was unknown at that time.

Shear, W[illiam] V.

How certified seed potatoes will benefit the California potato industry. Calif. Dept. of Agric. Monthly Bull. **9**(9): 375–391. 1920.

Sheffield, F[rances] M[arion] L[ena], & Smith, J[ohn] H[enderson]

Intracellular bodies in plant virus diseases. Nature **125**(3141): 200, 1930.

The authors give the results of their studies on the x-bodies in the living epidermal hairs of *Solanum nodiflorum.*

The formation of intracellular inclusions in *Solanaceous* hosts infected with aucuba mosaic of tomato. Ann. Appl. Biol. **18**(4): 471–493, 1931.

These bodies were formed by inoculating aucuba mosaic into *Solanum nigrum, S. nodiflorum, S. Lycopersicum, Nicotiana tabacum* and *Hyoscyamus niger.* The author describes the formation of these bodies.

The development of assimilatory tissue in solanaceous hosts infected with aucuba mosaic of tomato, Ann. App. Biol. **20** (1): 57–69, 1933.

The author describes the development of the chloroplast in *Solanum nodiflorum, S. Lycopersicum* and *Nicotiana tabacum* and compares healthy and diseased plants. In plants infected with aucuba mosaic certain of the leaf tissues are devoid of plastids and the cells may be undifferentiated. The absence of chlorophyll is brought about by the inhibition by the virus of the development of the plastid primordia.

Virus diseases and intracellular inclusion in plants. Nature **131**(3305): 325–326, 1933.

Description of experiments conducted to determine whether reactions in certain *Solanaceae* similar to those induced by inoculation with *aucuba* mosaic of tomato could be stimulated by physico-chemical means. The plants treated were tomato, *Solanum nigrum* and *S. nodiflorum.*

Shepard, E[dward] F[rederick] S[isnett]

Les maladies Mosaïques des plantes. (Mosaic disease of plants.) Rev. Agric. Ile Maurice **12**: 332–335, 1923.

(Summarized report on the position in relation to sugar-cane Mosaic in Reunion.) Rev. Agr. de L'Ile Maurice **13**: 59–61, 1924. (Rev. Appl. Mycol. **4**: 313, 1924 Maurice Dept. Agric. 3 p. 1924.)

Considerations sur la presence de la mosaïque á la Reunion. (Considerations about the presence of mosaic in Reunion.) La Rev. Agric. de L'Ile Maurice **19**: 384–389, 1925.

Mosaic disease serious in Reunion, Is. South African Sugar Journ. **9**: 97, 99, 101, 1925.

The author gives a general discussion of mosaic diseases with special reference to conditions in Reunion Island.

Les "streak disease" des gramines á Maurice, Is. (The "streak disease", of graminae in Mauritius, Is.) Rev. Agr. Ile Reunion. **11**(3): 352–357, 1925. (Rev. Agric. Ile Maurice, **22**: 540–542, 1925.)

Maize chlorosis. Notes on chlorosis of Maize and other graminaceas in Mauritius, Is. Trop. Agric. (Trinidad) **6**(11): 330, 1929. (Rev. Applied Mycol. **9**: 300, 1930.)

A chlorosis of maize at first believed to be mosaic is now believed to be streak.

Mycological Division, Maurice Is. Dept. Agric. An. Rpt. **1928**: 8–11, 1931.

Streak on maize and mosaic *Physalis peruviana*, cucurbits and *Brassica sinensis* is reported.

Diseases of sugar cane in Mauritius. Mauritius Dept. Agric. Bull. **41**, Gen. Ser. 27 p., 1931.

A popular publication on diseases of sugar cane, containing some data on mosaic.

Shevchenko, I. S.

(Report on the mosaic-disease of the sugar beet at the phytopathological section of the kharkov Regional Agricultural Experiment Station for 1928–29.) In V. P. Muraviov. Mozaichnye Bolezni Sakharnoi Svekly (Mosaic diseases of sugar beet Kiev, S.S.U. Soiuzsakhara p. 67–98, 1930. (English Abstract p. 97–98.)

Continuation of Proida's work, during 1928–29. Studies on transmission were undertaken. It was found that mosaic produces 1.1 per cent decrease in sugar content of the beet as maximum and 0.75 per cent as average and 12.9 per cent on beet seed output. No variety proves to be immune. It was found that the distance from the main source of infection is a factor as well as surface relief. wind direction and velocity.

Shevchenko, L. M.

(The development of mosaic on the sugar beet in relation to the date of sowing.) In V. P. Muraviov, Mozaichnye. Boloezni Sakharnoi Svekly (Mosaic diseases of sugar beet) Kiev. S.S.U. Soiuzsakhara p. 167–176, 1930. (English Abstract p. 175–176.)

Comparable data of 1927 and 1928 sugar-beet crops. The second year crop showed decidedly more infection than the previous year.

Shevchenko, V. I.

(Injury which the mosaic produces on the sugar beet.) In V. P. Muraviov., Mozaichnye Bolezni Sakharnoi Svekly (Mosaic diseases of sugar beet). Kiev, S.S.U. Soiuzsakhara p. 161–166, 1930. (English abstract p. 166.)

The author states, based on his observations during 1928 that no injury due to mosaic was recorded on beets. Weight of beets and sugar yields were observed and recorded on diseased plants, as well as seed produced.

Shirreff, John

On the curl disorder in potato. Caledonian Hort. Soc. Memoirs 1: 60–64, 1914.

Sieg, F. L.

Die Mosaik-krankheit der Gurken. (The mosaic disease of cucumber.) Gärtner Borse 10: 363, 1928.

Sieger, E.

Ein Beitrag zur Erforschung der Kartoffelblattrollkrankheit. (A contribution to the investigations of potato leaf roll disease.) Zeitschr. Spiritusind. 31: 415, 1908.

Siemaszko, Wincenty

Choroby drzew i krzewów owocoroych (Diseases of fruit trees and brush fruit.) Bibluoteka Oytawsja No. 6. Pulaway, 81, p. 3, 1930.

Supplement to diseases of cultivated plants, gives brief accounts of over 70 virus diseases occurring in Poland.

Silberschmidt, K[arl]

Der Einfluss der Mosaikkrankheit auf den Nikotingenhalt der Tabakpflanze. (The influence of the mosaic disease on the nicotine content of the tobacco plant.) Ber. Deutsch. Bot. Gesellsch 48(1): 122–129, 1930.

The writer gives details of his experiments to determine the relative nicotine contents of healthy and mosaic-diseased tobacco; diseased-

plant leaves showed a higher nicotine content. He suggests that it is due to assimilation of albumen and the formation of nitrate and formaldehyde.

Studies zum Nachweis von Antikörpern in Pflanzen II. Teil B. (Beiträge zur Frage der Resistenz und Immunität von Pflanzen gegenüber dem in fizierenden Agens der Viruskrankheiten.) C. Studies in the detection of antibodies in plants. II Part B. (Contributions to the problem of resistance and immunity in plants in relation to the infective principle of the virus diseases.) Beitr. Biol. der Pflanzen, **20**(2): 105–178, 1932.

A very extensive and comprehensive account of the author's studies on the occurrence of antibodies in tobacco plants conferring immunity from mosaic.

Simmonds, J[ohn] H[oward]

Spotted wilt of tomatoes. Queensland Agric. Journ. **28**: 28, 1927.

Bunchy top disease of bananas in Queensland. Queensland Agric. Journ. **30**(4): 438–442, 1928. (Trop. Agric. (Ceylon) **72**(3): 152–154, 1929.)

Bunchy top of the banana and its control. Queensland Agric. Journ. **41**(3): 241–244, 1934.

Brief article describing the disease, giving points concerning the nature and spread of it, and methods of control.

Simonetto, M[oisés]

Plan de investigaciones urgentes sobre las causas concomitantes de la plaga mosaico en la caña de azúcar. (Plan of urgent investigations about the symptomatic causes of the sugar cane mosaic disease.) Rev. Agric. Com. y Trab. Cuba **3** (9): 351, 1920.

Nuevas orientaciones en sanidad vegetal. (New orientations about vegetable sanitation.) Rev. Agric. Com. y Trab. Cuba **3**(9): 349–356, 1920.

Las Rayas Amarillas en la Caña de Azúcar. (Yellow stripes of Sugar Cane.) Cuba Azucarera. Sept. 15, p. 14, 1920.

La enfermedad de las rayas amarillas en la caña: Su importancia y extensión en Cuba. (The yellow-stripe disease in Cane: Its importance and extension in Cuba.) Oficina de Sanidad Veg., Sec. Agric. Com. y Fábrica de Cuba. Bol. **3**, 63 p., 1921.

The author gives a general discussion with recommendations for control.

La enfermedad de las rayas amarillas en la caña de azúcar. Réplica al Dr. S. C. Bruner. (The yellow stripe disease of sugar cane. Reply to Dr. S. C. Bruner.) Rev. Agric. Com. y Trab. Cuba **5**(4): 11–13, 44–48, 1922. (Sugar **24**: 641–642, 1922.)

Controversial. A reply to Dr. S. C. Bruner.

Cómo se debe determinar con buena aproximación el porcentaje de cañas enfermas en un cañaveral infectado con el mosaico. (How to determine approximately the percentage of diseased canes in a cane field infested with the mosaic.) Rev. Agric. Com. y Trab. Cuba **5**(3): 26–27, 1922.

Simpson, J.

The potato curl. Gard. Chron. N.S. 4: 143, 1875.

Historical value.

Sirotina, M. (Mme.)

(Cytological studies of sugar beet mosaic.) Sugar Ind. Scient. Notes Kieff, Grey ser. **9**(24): 195–216, 1932. (With English summary.)

A rather extensive account of the author's observations from her studies on the subject.

Skeete, C. C.

Sugar cane mosaic diseases. Barbados Dept. Agric. Ann. Rpt. **1927–28**: 15–16, 1928.

A brief report.

Skinner, J[oshua] J[ohn], & Demaree, J[uan] B[rewer]

Relation of soil conditions and orchard management to the rosette of pecan trees. U.S.D.A. Bull. **1378**, 16 p., 1926.

The increase of organic matter in the soil causes an increase in growth and yield.

Skoric, V[ladimir]

Bolestibilja ne fakultetskom dobru "Maksomir" (Plant diseases at the University Farm "Maksimir".) Rapp. Ann. Univ. de Zagreb **1929**: 723–746, 1930.

Bean and potato mosaic.

Slosson, Edwin E[mery]

Starting a new disease of the class called mosaic disease. Sci. Monthly **20**: 331–333, 1925. (Lit. Digest **85**: 24, 1925.)

Popular.

Small, W[illiam]

Bunchy-top disease of plantains in Ceylon. Trop. Agric. (Ceylon) **71**(5): 141–147, 1928.

The author doubts that this disease is due to a virus. He says that there is some evidence that it is caused by a fungus *Rhisoctonia Bataticola.*

Smith, A. C.

Virginia mountain grown seed potato demonstrations (Mosaic). Proc. Amer. Soc. Hort. Sci. p. 168–173, 1925.

Smith, A. J. M.

Bitter pit in Apples. A review of the problem. Dept. Sci. & Indus. Res. Food Invest. Bd. Special Rpt. **28**, 24 p., 1926.

Brief description of the characteristic symptoms, a critical review in some details of the theories on this disease, he admits the disease to be functional and not parasitic. This paper was written before the cause was known.

Smith, C[harles] E[gan]

Report on peach yellows. U.S.D.A. Comm. p. 393–398, 1889.

Notes on the Michigan diseases known as "little peach". Fennville Herald (Michigan) Oct. 15, 1898.

Transmission of cowpea mosaic by the bean leafbeetle. Science. **60**(1551): 268, 1924.

Evidence indicates that the cowpea mosaic may be carried by the bean leaf-beetle *Ceratoma trifuroata* Forst.

Smith, Erwin F[rink]

Peach yellow. A preliminary report. U.S.D.A. Div. of Bot. Bull. **9**, 254 p. 1888.

A very extensive publication giving the history of the disease, geographical distribution, characteristics, losses, relationships to climate and soils, methods of transmission and legislation.

Additional evidence of peach yellows and peach rosette. U.S.D.A. Div. Veg. Path. Bull. **1**, 65 p., 1891.

Describes these two diseases and gives the results of extensive experiments.

The chemistry of peach yellow I & II. Proc. Ouner Pomol. Soc. 1889, 1891.

The peach rosette. Journ. Mycol. **6**(4) : 143–148, 1891.

The disease is described. The author states that the beetles *Scolytus regulosus* does not transmit the disease. He also states that he observed the disease in cultivated plums and hard-shell almonds.

Peach yellows. Proc. Penninsular Hort. Soc. Jan. 22, 1891.

Experiments with fertilizer for the prevention and cure of Peach Yellows. U.S.D.A. Div. of Veg. Path. Bull. **4**, 187 p. 1893.

Additional notes on peach rosette. Journ. Mycology **7** : 226–232, 1893.

Additional data to that given in bulletin 1, Div. Veg. Pathology, U. S. Dept. Agric. p. 189. The disease was transmitted by budding. No organism has been found.

Peach yellows and peach rosette. U.S.D.A. Farmers' Bull. **17**, 20 p., 1894.

A popular discussion of the subject.

Notes on the Michigan disease known as ' little peach,'' an address before the Saugatuck and Ganges pomological Society. 12 p. Reprinted from Fenville (Mich.) Herald, Oct. 15, 1898.

Popular.

Communicability of peach yellows and little peaches. U.S.D.A. Div of Veg. Path. **1** : 45–58, 1901.

The sereh disease of sugar cane. Bacteria in Relation to Plant Diseases **3** : 72–80, 1914.

The author treats the disease from the standpoint of bacteriology.

Smith, F. E. V.

Report of the Government Microbiologist. Ann. Rpt. Dept. of Agric. Jamaica **1927**: 18, 19, 1928. (Rev. Appl. Mycol. **7**: 492, 1928.)

Smith, F[anny] F[ern]

Some cytological and physiological studies of mosaic diseases and leaf variations. Ann. Missouri Bot. Gard. **13**(4): 425–484, 1926.

The author reviews the literature, gives the results of experiments with light, the effects of chemicals on the inclusions, histological studies and variations in other plants.

Smith, Floyd, T[ranking]

The relation of insects to the transmission of raspberry leaf curl. Journ. Econ. Ent. **18**(3): 509–513, 1925.

The author reports the *Aphis rubiphila* as the carrier of raspberry leaf curl.

Smith, J[ohn] Henderson

Recent work on virus diseases in plants. Proc. Roy. Soc. Med. **20**: 11–18, 1927. (Rev. Appl. Mycol. (Abstract) **6**: 501, 1927.)

Experiments with a mosaic disease of tomato. Ann. Appl. Biol. **15**(2): 155–167, 1928.

A description and properties of a disease which is probably the same as Johnson's tobacco virus 6.

The transmission of potato mosaic to tomato. Ann. Appl. Biol. **15**(4): 517–528, 1928.

This paper gives the results of transmission by mutilation of the foliage.

Virus diseases in plants. Translocation within the plant. II. The amoeboid intracellular inclusions. Biol. Rev. & Biol. Proc. Cambridge Phil. Soc. **5**(2): 159–170, 1930.

The author states that we have little knowledge as to the mechanical routes for the spread of the virus. It probably travels from cell to cell and into the water stream but mainly by the phloem. The author gives a full description of the x-bodies which he believes are "a reaction product of the cell to the virus irritant."

Intracellular inclusion in mosaic of *Solanum nodiflorum*. Ann. Appl. Biol. **17**(2): 213–222, 1930.

The author gives the results of inoculating *Solanum nodiflorium* with the virus of yellow (aucuba) mosaic of tomato. Two types of bodies were studied in the living cells, cristalline spikes and amoeboid bodies. The latter corresponds to the x-bodies described by many students. The author describes them in detail and says no evidence in these investigations proves them to be organisms.

The differentiation and classification of plant viruses. Rpt. Proc. 5th, Inter. Bot. Congr. Cambridge p. 373–374, 1930.

Virus diseases of plants. In: System of Bact. i. Relat. Medic. London, Vol. **7**: 42–53, 1930.

A brief review of this subject.

Rothamsted Experiment Station Report for **1931**: 1–199, 1932.

Studies on certain particles found associated with virus diseases.

Some aspects of virus diseases in plants. Empire Journ. Expt. Agric. **1**(3): 206–214, 1933.

A critical review of our present knowledge of this group of diseases. In conclusion he states: "Although much yet remains to be done both from fundamental and practical aspects, the virus problem is far from being a hopeless tangle."

Streak in tomatoes aseptically grown. Ann. Appl. Biol. **20** (1): 117–122, 1933.

Two types of bacteria are found in tomato and tobacco plants with streak disease. Experimental work does not show any relationship to the disease.

Smith, Kenneth M[anley]

Mosaic disease of plants. Nature **110**: 668, 1922.

A record of the finding of intra-cellular bodies in tissue of potato plants.

Some peculiar pathological conditions in the leaves of potatoes affected with mosaic diseases. Rept. Int. Conf. Phytopath. & Econ. Ent. Holland, p. 30. H. Veenman & Sons. Wageningen, 1923.

This paper gives the results of cytological studies on vacuolate bodies and nucleolar extensions in cells from chlorotic areas.

On a curious effect of mosaic disease upon the cells of the potato leaf. Ann. Bot. 38(150): 385–338, 1924.

A record of amoeba-like bodies closely associated with the nuclei.

A comparative study of the feeding methods of certain Hemiptera and the resulting effect on the plant tissue, with special reference to the potato plant. Ann. Appl. Biol. 13(1): 109–138, 1926.

A very interesting discussion, is included, of the relations of the facts elucidated in the study to the question of the transmission of the virus diseases of the potato by sucking insects.

Observations on some insect carriers of potato virus diseases. Mem. & Proc. Manchester Lit. & Philos. Soc. (Abstract) 71: 9–10, 1927.

Observations on the insect carriers of mosaic disease of the potato. Ann. Appl. Biol. 14(1): 113–131, 1927.

A record of preliminary experiments with insect vectors and a list of insects that gave positive results.

A study of the feeding methods of certain sucking insects in relation to the spread of virus diseases of the potato by such insects. Mem. & Proc. Manchester Lit. & Philos. Soc. (Abstract) 70: 11–12, 1927.

Insects and potato virus diseases. Nature. 121(3058): 904, 1928.

The author passes the virus from a mosaic potato through tobacco and back to potato and produced intensified symptoms. The original virus could not be transmitted by *Mysus persicae* but modified virus was transmitted.

Insects in relation to potato virus diseases. Journ. Min. Agric. 37(3): 302–344, 1929.

Studies on potato virus diseases. 4 Further experiments with potato mosaic. Ann. Appl. Biol. 16(1): 1–13, 1929.

Positive proof of the transmission of potato mosaic by *Mysus persicae*. When potato mosaic virus was inoculated into healthy tobacco it produced ring spot. It is difficult for *M. persicae* to transmit the virus back to potato.

Studies on potato diseases. 5—Insect transmission of potato leaf roll. Ann. Appl. Biol. **16**(2): 209–229, 1929.

This is an extension of previous studies of this same subject.

Studies on potato virus diseases. 6—Further experiments with the virus of a potato mosaic upon the tobacco plant. Ann. Appl. Biol. **16**(3): 382–399, 1929. (Rev. Appl. Mycol. **9**(2): 124, 133, 1930.)

An interesting report on cross-inoculation of tobacco with potato mosaic, resulting in four types of ring spot.

Studies on potato virus diseases. 7—Some experiments with the virus of a potato crinkle with notes on interveinal mosaic. Ann. Appl. Biol. **17**(2): 223–240, 1930.

This paper contains records of the author's experimental work on transmission of several virus diseases of potato.

Insects in relation to potato virus disease. Journ. Min. Agr. (Gt. Britain) **37**(3): 224–232, 1930.

Popular.

Transmission of potato leafroll. Nature (London) **126**(3168) 96, 1930.

On the composite nature of certain potato virus diseases of the mosaic group as revealed by the use of plant indicators, and selective methods of transmission. Proc. Roy. Soc. Bot. **109** (762): 251–267, 1931.

The author describes the technique for the isolation of two viruses, X and Y, from a symptomless streak carrying potato. Y is liable to fluctuation in virulence, X varies and causes several symptoms. The author believes that the different symptoms of various mosaic diseases are caused by strain of X rather than by different viruses.

Virus diseases of potatoes. Second Int. Cong. Path. Fac. Méd. Univ. Paris **2**, 1931.

Thrips tabaci Lind. as a vector of plant virus disease. Nature **127**(3214): 852–853, 1931.

Reports that this insect can transmit the virus of ring-spot to *Solanum Capsicastrum*, *Datura* and tobacco. Also the spotted wilt of tomato and a virus disease of Dahlia.

Studies on potato virus diseases. 8—On a ring-spot virus affecting Solanaceous plants. Ann. Appl. Biol. **18**(1): 1–15, 1931.

Ring spot disease of the virus type of *Solanum capsicastrum* is first reported from the British Isle. Extensive discussion of solanaceous virus disease follows.

Studies on potato virus diseases. 9—Some further experiments on insect transmission of potato leaf-roll. Ann. Appl. Biol. **18**(2): 141–158, 1931.

Continuation of previous works by the author.

Composite nature of certain potato viruses of the mosaic group. Nature **127**(3210): 702, 1931.

Natural and artificial manners of inoculation are discussed in regard to reaction on the plant to different types of mosaic.

Virus diseases of plants and their relationship with insect vectors Biol. Rev. and Biol. Proc. Cambridge Phil. Soc. **6** (3): 302–344, 1931.

A review of the subject with about 250 references in the bibliography. All known plant viruses are listed according to host plants and insect carrier given where known.

Filtration of plant viruses. Nature. **130**(3276): 243, 1932.

Reports results similar to those carried on by MacClement and Henderson Smith. (Nature 130: 129, 1932.)

Studies on plant virus diseases XI. Further experiments with a ring-spot virus: its identification with spotted wilt of tomato. Ann. Appl. Biol. **19**(3): 305–330, 1932.

A study of the English ring spot which is transmitted by *Thrips tabaci.* This disease which was first described from *Solanum capsicastrum* appears to be the same as the spotted wilt of Australia. It attacks a number of plants.

The present status of plant virus research. Biol. Rev. **8**(2): 136–179, 1933.

A very excellent review of our knowledge up to this time.

Spotted wilt: An important virus disease of the tomato. Journ. Min. Agric. **39**(12): 1097–1103, 1933.

Popular description and discussion of the disease which is widely spread in England.

Recent advances in the study of plant viruses. London, 423 p., 1933.

A book containing much valuable data.

Some virus diseases of the potato and other farm crops. Scottish Journ. Agric. 16(4): 446–456, 1933.

The author gives a comprehensive definition of a virus and a general review of present knowledge on the virus diseases of potatoes and other crops and their transmission by insects.

Smith, L[oren] B[arlett]

Spinach blight and its transmission by insects. Virginia State Ent. and Plant Path. Rpt. 11(1916–17): 40–50, 1918. (Phytopathology (Abstract) 8(1): 14, 1918.)

A review of the paper by McClintock and Smith (1918).

The life history and biology of the pink and green aphid (*Macrosiphum solanifolii*, Ashmead.) Virginia Truck Expt. Sta Bull. 27: 27–79, 1919.

Potato spraying experiments on the control of the pink and green aphid (*Macrosiphum solanifolii*, Ashmead.) Virginia Truck Expt. Sta. Bull. 29, pt. 1, p. 101–118, 1919.

Breeding mosaics resistant spinach and notes on malnutrition. Virginia Truck Expt. Sta. Bull. 31–32: 137–160, 1920.

Smith, R[alph] E[lliott]

Growing China asters. Massachusetts Hatch Expt. Sta. Coll. Agric. Bull. 79, 26 p., 1902.

The author gave twelve pages to this diseases long before the cause was known.

Beet-blight investigations. California Agr. Expt. Sta. Bull. 184: 240–241, 1908.

———, **& Smith E[lizabeth] H[ight]**

California plant diseases. Calif. Agric. Expt. Sta. Bull 218: 1039-1193, 1911.

The investigation of "Physiological" plant diseases. Phytopathology 5(1): 83–93, 1915.

This is a general paper which includes a brief discussion of virus diseases.

_____________, & Boncquet, P[ierre] A[uguste]

New light on curly top of the sugar beet. Phytopathology **5**(2): 103–107, 1915.

_________, & ___________

Connection of a bacterial organism with curly leaf of the sugar beet. Phytopathology **5**(6): 335–342, 1915.

The authors corroborate the findings concerning the relation of *Eutettix tenella* to this disease, give a brief discussion of the histology of the diseased plants and of a bacterium found in them.

The beet leafhopper and curly-leaf disease that it transmits. Phytopathology **8**(4): 168, 1918.

A complementary statement concerning Dr. E. D. Ball's Bulletin 155 of Utah Agric. Expt. Sta., 1917, "The beet leafhopper and the Curly-leaf Disease that it Transmits."

Smith, Roger C., & Barker, H[enry] D.

Observations on the "yellow disease of beans and related plants in Haiti." Journ. Econ. Ent. **23**(5): 843–847, 1930.

The disease is either caused by a virus which is transmitted by a leafhopper (*Empoasca* sp.) or caused by the insect. It is not transmitted in the seeds.

Smyth, E[ugene] Graywood

Entomological Work. (The yellow stripe disease of sugar cane.) Report of the Com. of Agric. & Labor of Puerto Rico. From Report of the Governor **1919**: 685–713, 1919.

Insects and mottling diseases. Journ. Dept. Agric. of Puerto Rico, **3**(4): 83–116, 1919. (Rev. Appl. Ent. Ser. A. **8**: 483, 1919.)

Gives a record of experiments conducted in an effort to determine the insect carriers of the disease. The results were negative.

List of the insects and mite pests of sugar cane in Puerto Rico. Journ. Dept. Agric. Puerto Rico. **3**: 135–150, 1919.

A paper prepared during the author's studies on insect transmission of the sugar-cane mosaic.

Report Division of Entomology. Ins. Expt. Sta. Puerto Rico Ann. Rpt. **1919–20**: 83–89, 1920.

Snell, K[arl]

Panaschierung an Kartoffelblattern. (Variegations of potato leaves.) Nachrichtenbl. Deutsch. Pflanzenschutzd. **3**: 77, 1923.

Snyder, William C.

Pod deformation of mosaic-infected peas. Phytopathology **34** (1): 78–80, 1934.

Review of Lindfora's report made on a pea-disease in 1928 (U. S. D. A Br. Plant Indus. Suppl. 67, 1929.) Discussion of his observations.

Sokal, N.

Nouvelles recherches sur le virus filtrant de la pomme de terre. (New researches on potato filterable virus.) Comptes Rendus Soc. Biol. **103**: 955–956, 1930.

Sollewijn, G.

Report over de serehziekte in het Cheribousche suikerriet. Indische Opmerker Maart 13, 1884.

Solovieva, Mme N. V.

(Observations on potato diseases in the Terek district in 1927–1928.) Bull. North Caucasian Plant. Prot. Stat. Rostoff on Don. **6–7**: 85–94, 1930.

Potato degeneration diseases, chiefly leaf roll is reported from that district.

Soltwedel, F.

De serehziekte. Meded. Proefst. Midden–Java, Samarang, 1889.

Sorauer, Paul C[arl Moritz]

(Note at the end of some papers on a disease of sugar cane.) Zeitschr. f. Pflanzenkrankheiten **1**(6): 360, 1891.

Die Augabliche Kartoffel-epidemic genennt die Blattrollkrankheit. International Phytopathologischer Dienst. **1**: 33-59, 1908.

Die neueren Untersuchungen von Quanjer uber die Ursache der Sorauer'sche Standpunht. Zeitschrift fur Pflanzenkranheiten, Bd. **23**(4): 244–253, 1913.

Die Mosaikkrankheit des tabaks. (Mosaic disease of tobacco.) Handbuch der Pflanzenkrankheiten, **1**: 678–683, 1909.

Soriano, S.

El "corcovo" y el "polvillo" del tabaco en la República Argentina. (The "hunchback" and the "powdery" of tobacco in the Argentine Republic.) Argentina Rev. Fac. Agron. & Vet. **7**(2): 371–392, 1931.

Account of these two diseases of occurrence in the Argentine Republic. The two diseases are fully described and the author concludes that "corcovo" and "polvillo' are varying manifestations of a single disease of the virus group. Both are decidedly infectious.

Notas sobre algunas enfermedades de los vegetales producidos por "virus" en la República Argentina. (Notes on some vegetables diseases caused by "virus" in the Argentine Republic.) Physis, Buenos Aires **11**(38): 87–90, 1932.

Sornay, P. de

Mosaic in imported canes. Rev. Agricole Maurice, **1928**: 12, 1928.

The author suggests that the virus may be present in apparently immune canes. A brief paper suggesting mosaic may be dormant in canes.

Sorokin, Helen [Petrovna]

The destruction of the chloroplasts in tomato mosaic Phytopathology (Abstract) **16**(1): 66–67, 1926.

Phenomena associated with the destruction of the chloroplasts in tomato mosaic. Phytopathology **17**(6): 363–370, 1927.

Southwell, H.

Virus diseases of potatoes and the raising of seed potatoes in the Irish Free State. Journ. Minis. Agric. **34**(1): 19–25, 1927.

Popular account of the subject. Brief review of the work done by research workers, description of the disease, nature and the production of healthy seed are discussed.

Spaeth, C. P., & Kraybill, Henry R[eist]

A bio-chemical study of the false-blossom disease of the cranberry. Journ. Agric. Res. **34**: 35–48, 1927.

Diseased plants are higher in reducing sugar, sucrose, starch, acid-hydrolyzable substances and dry matter, than healthy plants. They are lower in moisture. No difference in nitrogen content.

Speare, A[lden] T[rue]

Yellow-stripe disease. Hawaiian Planters' Record **10**(4): 381–382, 1914.

Spieckermann, A[lbert]

Beiträge zur Kenntnis der Bakterienring-und Blattrollkrankheit der Kartoffelpflanze. Jahresbericht, Vereiningung fur Angewandte Botanik, Jaarhg. 8, 1910, p. 1–19, 173–177, 1911.

Untersuchungen über die Kartoffelpflanze und ihre Krankheiten. In Gemeinschaft mit P. Kotthoff. Landwirtschaftliche. Jahrbüche, **63**: 659–732, 1914.

Die Beurteilung der mosaikrankheit bet der Anerkennung. Die Kartoffeln **2**: 111–113, 1922.

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Spisar, K[arl]

Einiger über die curly-leaf Krankheit der Zuckerrübe. Ztschr. Zuckerindus. Böhmen, **34**: 345–349, 1910.

Sprecher, A[ndreas]

Recherches mycrocopiques sur les sucs végétaux. (Microscopical researches about the vegetable saps.) (Mosaic diseases and variegations.) Rev. Gén. Bot **33** · 6–33, 1921.

Sreenivasaya, M., & Sastri, B. N.

Contributions of the study of spike-disease of Sandal (*Santalum Album* Linn.) I. Diastatic activity of the leaves. Journ. Indian Inst. Sci. **11A**(3) : 23–29, 1928.

————————, **& Gopalaswami Naidu, G.**

Contribution to the study of spike disease of Sandal (*Santalum album* Linn.) Part V, Transmission of spike by budding. Journ. Indian Inst. Sci. **11 A** (19) : 244–247, 1928.

This was transmitted by budding and showed symptoms in 131 days.

————————, **& Sastri, B. N.**

Contributions to the study of spike disease of Sandal (*Santalum album* Linn.) Part VIII. Chemical composition of tissue fluid from the leaf. Journ. Indian Inst. Sci. **12 A** (17) : 239–244, 1929. (Rev. Appl. Mycol. **9**(5) : 277, 1930.)

Diseased plants contain less ash and calcium and more nitrogen, maltose and reducing sugar than healthy trees.

Contribution to the study of spike disease of Sandal (*Santalum album* Linn.) Part IX. Chemical composition of tissue from the stem. Journ. Indian Inst. Sci. **12 A** 17: 245–250, 1929. (Rev. Appl. Mycol. **9**(5) : 277, 1930.)

Diseased plants contain more nitrogen, phosphorus and calcium than healthy plants.

Contribution to the study of spike-disease of sandal (*Santalum album* Linn.) Part XI. New method of disease transmission and their significance. Journ. Ind. Inst. Sci. **13 A** (10) : 113–117, 1930.

A report of experimental work in grafting and leaf infection.

Ocurrence of manitol in spike disease of sandal (*Santalum album* Linn.) Nature **126**(3177) : 438, 1930.

Manitol appears to be one of the metabolic products of the virus.

Masking of spike-disease symptoms in (*Santalum album* Linn.) Nature **126**(3190) : 957, 1930.

The author believes that masking of the symptoms is influenced by intense sunshine and temperature.

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Contribution to the study of spike-disease of sandal (*Santalum album* Linn.) Part XII. Ecology of sandal. Journ. Indian Inst. Sci. **14 A** (5) : 59–65, 1931.

A survey was made to determine the relation of sandal-wood hosts to the spike disease. There is some evidence that sandal spike on certain hosts is more susceptible than on other hosts.

Stahel, Gerold

De Zeefvatenziekte (phloëmnecrose) van de Liberikoffie in Suriname. (Phloem necrosis of Liberian coffee in Suriname.) Meded. Dept. Landb. Suriname, Bul. **12**, 2 p. 1917.

The author proposes the name phloem-necrosis disease due to features resembling leaf roll of potato and sereh of sugar cane.

Phloem necrosis of Liberia coffee in Suriname. Dept. Landb. Suriname Bull. **40**, 31 p., 1920.

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Nieuwe onderzoekingen over de zeefvatenziekte (phoëmnecrose) van den Koffi in Suriname. (New researches about phloem-necrosis of coffee in Suriname.) Indische Mercuur **53**(42) : 919–921, 1930.

Phloem-necrosis attacks all species of coffee (*C. arabica*, *C. robusta*) in Surinam and is the most serious disease. The living sieve tubes contains a *Phytomonas* sp. which is similar to *P. Davidi*, but smaller.

Zur kenntnis dessiebrohrenkrankheit (Phloemnecrosis) des karfubaumes in Surinam. I. Mikrospische untersuchungen und infektionsversuche. (Contribution to the knowledge of the sieve-tube diseases (phloem necrosis) of the coffee tree in Surinam. I. Microscopic investigations and inoculation experiments.) Phytopath. Zeitschr. **4**(1) : 65–82, 1931.

The most serious diseases of Liberian coffee in Surinam. Not known in any other country. An organism has been found in the sieve tubes which is described as *Phytomonas leptovasorum.*

Zur kenntnis der siebrohrenkrankheit (Phloemnekrose) des kaffeebaumes in Surinam. II. (Contribution to the knowledge of the sieve-tube disease (phloem necrosis) of the coffee tree in Surinam. II.) Phytopath. Zeitschr., **4**(5) : 539–544, 1932.

The author reports excessive necrosis in diseased plants. The red-disease of Brazil shows similar symptom. The disease was observed in Pernambuco and Parahyba in 1917.

Verlag van den directeur. (Report of the Director) Suriname Dept. Agric. Expt. Ann. Rept. **1931–32** : 5–34, 1933.

Continuation of previous work on sieve tube (Phloem necrosis) of coffee trees.

Zur Kenntnis der Siebröhrenkheit des Kaffeebaumes in Suriname III. (On the study of the "Sieve tube disease" (Phloemnecrosis) of the coffee tree III.) Phytopath. Zeitschr. **6**(4) : 335–357, 1933.

Description of the disease and detailed account of the work done up to the present on this obscure disease.

Stahl, C[orwin] E[loyd,] & Carsner E[ubanks]

Obtaining beet leafhoppers non virulent as to curly top. Journ. Agric. Res. **14**(9) : 393–394, 1918.

Gives method of obtaining beet leafhopper which were nonvirulent as to curly top.

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A discussion of *Eutettix tenella* (Baker) as a carrier of curly-top of sugar beets. Journ. Econ. Ent. **16**(6) : 476–479, 1923.

A mosaic of corn. Proc. 2nd Conf. Internat. Soc. Sugar-Cane Technologists **1927** : 85–87, 1927.

The most common mosaic of corn in Cuba produces stripping. It is carried from corn to corn by *Peregrinus maidis.* The sugar-cane mosaic is carried from cane to corn by *Aphis maidis.*

Corn stripe disease in Cuba not identical with sugar-cane mosaic. Trop. Plant Res Foundation Bull. **7**: 3–11, 1927. (Rev. Appl. Ent. Ser. A. **17**: 420, 1927; Rev. Appl. Mycol. **7**: 158–160, 1927.)

This paper gives proof that the corn-stripe disease of Cuba which is similar to sugar-cane mosaic is different. The disease is transmitted by a leafhopper (*Peregrinus maidis*, Ashm.) and apparently not transmitted by *Aphis maidis*, Fitch.

————————, & **Faris, J[ames] A[braham]**

El comportamiento de las nuevas cañas P. O. J. en relación con la enfermedad del mosaico de la caña de azúcar en Cuba. (The behavior of the new P.O.J. canes toward mosaic.) Est. Exp del Club Azucarero de Cuba, p 13, 1929, (Trop. Plant Res. Foundation, Bull. **9**, 12 p., 1929.)

The authors discuss the comparative resistance of several varieties, the results of inoculation of several varieties by means of *Aphis maidis*. The paper closes with a discussion of resistance, immunity and tolerance.

Stakman, E[lvin] C[harles]

Raspberry mosaic. Minnesota Hort. **53**(3): 85–87, 1925.

Stanley, W. M.

The action of trypsin on tobacco-mosaic virus. Phytopathology (Abstract) **24**(1): 18, 1934.

Standford, E[rnest] E[lwood], & Davy, E[dward] D[awson]

Alkaloidal content of daturas affected by mosaic injury. Science, n.s. **58**(1509): 450–451, 1923.

Staner, P.

Belgian Congo: A new disease of sisal. Int. Bull. Plant. Protect. **3**(12): 183, 1929 (Rev. Appl. Mycol. **9**: 316, 1930.)

Note on a filterable virus disease of sisal, apparently new.

Mosaïque des feuilles de manioc. (Mosaic of Cassava leaves.) Bull. Agric. Congo Belge, **22**(1): 75–80, 1931.

A brief description of inoculations and filtration experiments.

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Un état pathologique du Sisal au Congo Belge. Bull. Agr. Congo Belge **21**: 864–866, 1931.

Starrett, Ruth Colvin

A new host of sugar-beet curly top. Phytopathology **19**(11): 1031–1035, 1929.

The author gives proof that *Oxalis stricta* is a susceptible host to the curly-top virus.

Stell, F.

Sugar-cane mosaic in Trinidad. Int. Sugar Journ. **31**(368): 414–415, 1929. (Rev. Appl. Mycol. **9**(2): 131–132, 1930.)

A brief report.

Stepanoff, K. M.

(Some observations on the curling of tomato leaves in the district of Astrakham.) Comment. Inst. Astrachanesis ad defensionem plantarum **2**(4): 41–54, 1930.

The author believes that the disease he is dealing with is the same or similar to that described by Güssow (Phytopath. **11**(9): 380–383, 1921.) Evidence indicates that a virus is the causal agent.

Stevens, Neil E[verett]

Field observations on false blossom of the cultivated cranberry. Phytopathology **15**(1): 85–91, 1925.

———, **& Sawyer Jr., W[illiam] H[ayes]**

The distribution of cranberry false blossom. Phytopathology **16**(3): 223–227, 1926.

The first statement in the literature that this disease is infectious.

The false blossom situation. Amer. Cranberry Growers' Assoc. Proc. Ann. Meeting **57**: 20–27, 1927.

Report of eight years' field studies. Conclusions reached that the disease is infectious and spread by insects. Control measures are discussed.

The false blossom situation in 1928. Wisconsin Cramberry Growers' Assoc. Proc. Ann. Meeting. **42**: 17–22, 1928.

The spread of cranberry false blossom in the United States. U. S. D. A. Circ. **147**, 18 p., 1931.

A very excellent discussion of the subject as indicated by the title.

Losses due to cranberry false blossom in New Jersey. Int. Bul. of Plant Protec. **7**(3): 53, 1933.

Popular.

Stevenson, John A[lbert]

Enfermedad de la caña de azúcar en Puerto Rico. (Sugar-cane disease in Puerto Rico.) Mundo Azucarero **5**(1): 19–24, 1917.

An epiphytotic of cane disease in Puerto Rico. Phytopathology **7**(6): 418–425, 1917.

La nueva enfermedad de la caña. (The new sugar-cane disease.) Puerto Rico Ins. Expt. Sta. Circ. **11**, 12 p., 1917. (Louisiana Planter & Sugar Manufacturer, **59**: 76–78, 1917, Agric. News Barbados, **16**: 286, 1917.)

A paper on the sugar-cane mosaic in Puerto Rico.

Report of the Pathologist for 1917. Ins. Expt. Sta. Puerto Rico Ann. Rpt. **1916–17**: 37–77, 1917.

A report on the presence of sugar-cane mosaic in Puerto Rico.

La enfermedad nueva de la caña. (The new sugar-cane disease.) Rev. Agric. Puerto Rico, **1**(1): 18–25, 1918.

A detailed popular account of sugar cane mosaic. The author states that the disease appeared to be in the Island for several years previously; but very recently that it has attracted attention and become a serious menace to the sugar industry in Puerto Rico. The author discusses the disease giving symptoms, susceptible varieties, means of transmission and control measures.

Notas sobre medios de combatir el matizado de la caña. (Notes on how to control sugar-cane mosaic.) Rev. Agric. Puerto Rico, **2**(2): 11–12, 1918.

Brief notes devising the means to fight mosaic of sugar cane.

La enfermedad del mosaico del tabaco. (Tobacco mosaic disease.) Rev. Agric. Puerto Rico **2**(1): 39–44, 1918.

El matizado de la caña. (Sugar-cane mottling.) Rev. de Agric. de Puerto Rico, **2**(1): 51–52, 1918.

Brief note stating that mosaic is due to virus and not to fertilizers or soil conditions.

The mottling or yellow-stripe disease of sugar cane. Journ. Dept. Agric. Puerto Rico, **3**(3): 3–76, 1919.

A very lengthy paper giving distribution on the Island, rate and manner of spread, varietal susceptibility, symptoms, field culture relations, possible causes and methods of transmission, plot experiments and methods of control.

Control of sugar-cane mottling disease. Sugar **23**: 92–95; 539–554, 1921.

Gives a description of the disease and advises the use of immune or resistant varieties.

Stewart, F[red] C[arlton]

Two destructive lily diseases. New York, (Geneva) Agr. Expt. Station. Ann. Rept. **1895**: 520–524, 1896.

First record of the virus disease on Bermuda lily.

Potato diseases on Long Island in the season 1895. New York State Agric. Expt. Sta. Bull. **101**: 83–86, 1896.

Two destructive lily diseases. New York (Geneva) Agric. Expt. Sta. Ann. Rpt. **1895**: 520–524, 1896.

The first record of the lily mosaic.

Another stem blight of potatoes. New York State Agric. Expt. Sta. 15th Ann. Rpt. **1897**. 509–510, 1897.

The communicability of potato stem blight. New York State Agric. Expt. Sta. 16th Rpt., **1898**: 421–423, 1898.

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Raspberry cane blight and raspberry yellows. New York Agric. Expt. Sta. (Geneva) Bull. **226**: 331–366, 1902.

A brief record.

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The Spindle-Sprout Disease of Potatoes. New York (Geneva) Agric. Expt. Sta. Bull. **399**: 133–143, 1915. Popular Edition of the same. (Phytopathology (Abstract) **4**: 395, 1914.)

A study of field conditions. Cause unknown.

Observations on some degeneration strains of potatoes. New York Agric. Expt. Sta. Bull. **422**, 12 p., 1916.

Further studies on the effect of missing hills in potato field and on the same seed tuber. New York Agric. Expt. Sta. (Geneva) Bull. **389**, 52 p., 1921.

Raspberry mosaic. Fruit diseases problems of to-day. Proc. N. Y. State Hort. Soc. **1922**: 61–69, 1923.

Control of leaf roll and mosaic in potatoes by isolating and roguing the seed plant. New York (Geneva) Agric. Expt. Sta. Bull. **522**, 14 p, 1924.

Report of experimental data obtained during five seasons with leaf roll and mosaic diseases of potatoes.

Observations on masking of raspberry mosaic by high temperature. Phytopathology (Abstract) **15**(1): 80, 1926.

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Aphids as vectors of leaf roll among sprouting potato tubers. New York. (Geneva) Agric. Expt. Sta. Tech. Bull. **171**, 21 p., 1930.

After tests made by the authors, conclusions were reached that aphids are capable of spreading leaf roll among sprouting seed potatoes, confirming Murphy's assertion in Ireland. Control methods are given.

Aphids on potato sprouts. New York Agric. Expt. Sta. Circ. **119**, 6 p., 1931.

Aphids as vectors of leaf roll among sprouting potato tubers. Phytopathology (Abstract) **21**(1): 103–104, 1931.

Stewart, V[ern] B[onhane], & Reddick, Donald

Bean mosaic. Phytopathology (Abstract) **7**(1): 61, 1917.

Stift, A[nton]

(Sugar-beet and potato diseases in 1908.) Centbl. Bakt. II Abt., **23**(6–9): 173–192, 1909.

(Some of the more important contributions in 1909 on the diseases of sugar beets and potatoes.) Centbl. Bakt. II, Abt. **26** (18–19): 520–560, 1910.

(A review of literature relating to diseases of sugar beets and potatoes.) Centbl. Bakt. I Abt., **33**(17–19): 447–496, 1912.

Stock, J[ohn] E[wald] van der

Proeve eener verklaring der gelestrepenziekte en der serehziekte. (Proof of a hypothesis of the yellow-stripe disease and the sereh disease.) Meded. Prof. Oost-Java Series 4, No. **36**: 457–477, 1907. (Arch. Java Suikerinders. Jaarg. **15**: 581–601, 1907.)

Stone, George E[dward], & Chapman, G[eorge] H[enry]
Report of the botanists. Massachusetts Agric. Expt. Sta. Rpt. p. 120–150, 1907.

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Investigations relating to mosaic disease. Massachusetts Agric. Expt. Sta. Rept. **20**: 136–144, 1908.

Stone, R[oland] E[lisha], & Howitt, John Eaton
Experiments with winter blight or streak of tomatoes. Phytopathology (Abstract) **12**(1): 41, 1922.

Winter blight or streak in tomatoes. Phytopathology **15**(5): 300, 1925.

The author reports success in controlling tomato streak or winter blight in commercial greenhouses by increasing phosphoric acid and potash in fertilizers.

Stoneberg, H[ugo] F.
The productiveness of corn as influenced by the mosaic disease. U. S. D. A. Tech. Bull. **10**, 18 p., 1927.

The results of extensive experimental work showing the importance of this disease.

Storey, H[arold] H[aydon]
The major cane diseases. South African Sugar Journ. Cong. & Exhibit. p. 54–61, 1923.

Treatment of mosaic in Natal. South African Sugar Journ. **7** (9): 745–747, 1923.

A disease of maize and its probable relation to the control of streak disease in Uba cane. South African Sugar Journal, **8**: 647–649, 1924.

Disease of sugar cane of the mosaic type in South Africa. Part I. Journ. Dept. Agric. South Africa, **9**(2): 108–117, 1924. (Rev. Appl. Ent. Ser. **A 12**: 469; Rev. Appl. Mycol. **4**: 122–123, 1924.)

A discussion of conditions with reference to the disease in South Africa.

The transmission of a new plant virus disease by insects. Nature **114**(2859): 245, 1924. (Rev. Appl. Mycol. **3**: 685–686, 1924.)

Transmission of a maize disease by *Balclutha* sp. The disease is similar to the mosaic of cane, maize and other grasses. The sugar-cane mosaic is transmitted by *Aphis maidis*.

Streak disease in Uba cane. Louisiana Planter & Sugar Mfg. **73**(15): 268–270. (South African Sugar Journal Congress & Exhibition number p. 63–66; Rev. Appl. Mycol. **4**: 123, 1924.)

A study of losses due to this disease. Losses 10 per cent.

Streak disease an infectious chlorosis of sugar cane, not identical with mosaic disease. Rpt. Imp. Bot. Conf. (London) July, 1924. Proc. p. 132–144, 1924. (Rev. Appl. Mycol. **4**: 442–443, 1924.)

The author gives evidence that the disease is an infectious chlorosis.

The influence of streak disease upon the yield of Uba cane. South African Sugar Journ. **8**(7): 519–522, 1924. (Rev. Appl. Mycol. **3**: 686, 1924.)

Experimental plots showed losses ranging from 30 to 50 per cent.

Streak disease of Uba cane. Journ. Dept. Agric. South Africa, **10**: 532–537, 1925.

Streak disease of sugar cane. Union of South Africa Dept. Agric. Sci. Bull. **39**, 30 p., 1925. (Rev. Appl. Mycol. **5**: 1–2, 1925.) Facts About Sugar, **20**(40): 953, 1925.

The author gives a review of the literature, the distribution, the symptoms, list of susceptible varieties of cane and a list of other species of plants. The disease causes losses of 12 to 50 per cent and is transmitted by a jassid leafhopper, *Balclutha mbila* (Naude). The author recommends the use of new varieties.

Streak disease of cane. South African Sugar Journ. Annual, p. 113–118, 1925.)

Sugar-cane diseases of the mosaic type in South Africa. Part II. South Africa Dept. Agric. Journ. **10**(6): 532–537, 1925. (Rev. Appl. Ent. ser. **A**. **13**: 393, 1925. Rev. Appl. Mycol. **5**: 2, 1925.)

The Transmission of streak disease of maize by leafhopper, *Balclutha mbila*, Naude. Ann. Appl. Biol. **12**(4): 433–439. 1925.

Although Uba cane is immune to mosaic, it is susceptible to streak. The disease is transmitted by leaf-hopper, *Balclutha mbila* (Naude).

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Transmission of rosette disease of the ground nut. Nature **116**: 97–98, 1925. (Agric. Journ. India **21**: 68–69, 1926.)

This disease is transmitted by *Aphis leguminosae.*

Interspecific cross-transmission of plant virus disease. South African Journ. Sci., **23**: 305–306, 1926. (Rev. Appl. Mycol. **6**: 377, 1927.)

The streak disease is transmitted from maize to maize by *Balclutha mbila.* Also from Uba to Uba cane. Failed to transmit from maize to Uba. Disease also reported on *Eleusine indica* and *Digitaria horizontalis.*

Recent researches on plant virus disease. South African Jour. Sci. (Summary), **23**: 307, 1926. (Rev. Appl. Mycol. **6**: 377, 1927; Int. Sugar Journ. **29**: 345, 487, 1927.)

A summary of recent work.

The cane disease situation. Urgency of the need for the control of mosaic. African Sugar & Cotton Planter **2**(7): 11–15, 1926. (Rev. Appl. Mycol. **6**: 54, 55, 1926.)

A warning as to the necessity for control.

The cane disease situation. Proc. 4th Ann. Congress So. Africa Sugar Assoc. **1926**: 69–73, 1926. (The Planter and Sugar Manuf. **78**(2): 28–30, 1927.)

The author believes that mosaic can be eradicated by the use of resistant varieties.

Rosette disease of ground nuts (*Aphis leguminosae* (Theo.).) Proc. S. & E. African Agric. Conf. Nairobi p. 213–214, 1926.

Streak disease of Uba cane. Jamaica Dept. Agric. Microb. Circ. **6**: 88, 89, 1926.

Strain of the viruses affecting the graminea. Proc. Conf. Int. Soc. Sugar-Cane Tech. **2**: 87–88, 1927.

Control of streak disease on maize and sugar cane. Proc. South & East Agric. Conf. 1926, p. 212, 213, 1927. (Rev. Appl. Ent. Ser. **A**. **15**: 569, 1927.)

Transmission studies of maize streak diseases. Ann. Appl. Biol. **15**(1): 1–25, 1928.

After the *Balclutha* (*Cicadula*) *mbila* feeds on diseased corn, 12–48 hours at 30–35 degrees C. incubation is necessary before it can transmit the disease. At lower temperature, a longer time is necessary.

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The Rosette Disease of Peanuts (*Arachis hypogaea* L.) Ann. Appl. Biol. **15**(1): 26–45, 1928

The authors give proof that it is a virus disease and that it is carried by *Aphis leguminosae.*

Plant pathology. First Ann. Rpt. East African Agric. Res. Stat., Amani **1928–1929**: 12, 1929. (Rev. Appl. Mycol. **9**(2). 88, 89, 1930.)

A record of mosaic of sugar cane, streak of maize, rosette of ground nut curly-leaf cassava and mosaic of tabacco.

A mosaic virus of grasses, not virulent to sugar cane. Ann. Appl. Biol. **16**(4): 525–532, 1929.

A discussion of a virus disease of maize and sorghum which is indistinguishable from sugar-cane mosaic. It is carried by *Aphis maidis.*

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The transmission of streak disease between maize, sugar cane and wild grasses. Ann. Appl. Biol. **17**(4): 691–719, 1930.

The authors give the results of transmission experiments with the streak disease on maize, sugar cane, *Digitaria horizontalis* and *Eleusine indica.* The virus from maize does not produce permanent infection in cane. The virus from Uba produces a mild form of the disease in maize. The disease occurs in P. O. J. 213 previously supposed to be immune. The authors give a list of wild grasses believed to be susceptible. The streak from *D. horizontalis* can be transmitted to maize and back but not to cane. *E. indica* was not infested with virus from cane or maize but was infested with virus from P. O. J. 213.

Plant Pathology. Second Ann. Rpt. East African Agric. Res. Stat. Amani. 1929–30, 1930.

The bearing of insect-vector on the differentiation and classification of plant viruses. Deuxiéme Congr. Internat. Path. Comp. Paris II. Comptes Rendus & Communications **2**: 471–479, 1932.

Review of our knowledges in regard to insect vectors and its relation to the virus disease type.

The inheritance by a leaf-hopper of the ability to transmit a plant virus. Nature **127**(3216): 928, 1931. (Proc. Roy. Soc. **B 112**(774): 46–60, 1932.)

Certain individuals of *Cicadulina mbila* inherit the ability to transmit the streak disease of corn. Others do not. This character can be fixed by breeding.

A new virus disease of the tobacco plant. Nature **128**(3222): 187, 188, 1931.

A new virus disease in Tanganyika. It has been transmitted by grafting and by an undetermined aleyrodid.

The filtration of the virus of streak disease of maize. Ann. Appl. Biol. **19**(1): 1–5, 1932.

This disease has not been transmitted from plant to plant by mechanical methods but is transmitted by *Cicadulina mbila.* Juice from diseased plants plus sucrose up to 10 per cent can be taken through membranes by the insect and inoculated into corn. The virus will pass Chamberland L1 and Berkefeld V filter (which retains *Bacillus pyocyaneum*), Chamberland L3 and Berkefeld N. Candles. It did not pass a Seitz E. K. disc.

Leaf curl of tobacco in Southern Rhodesia. Rhodesia Agric. Journ. **29**(3): 186–192, 1932.

The leaf curl, crinkling or frenching of Rhodesia are the same as crinkly dwarf in South Africa, Cabbaging in Nyasaland and Kroepoch in Java. It is transmitted by *Bemisia gossypiperda.*

Investigation on the mechanism of the transmission of plant viruses by insects. I. Proc. Roy. Soc. **B 113**: 463–485, 1933.

The author gives the results of studies which lead to the conclusion that the streak virus taken in by *Cicadulina mbila* passes through the wall of the intestine and into the blood. *C. mbila* was not successfully inoculated with the virus of maize stripe and mosaic diseases; nor *Peregrinus maidis* and *Aphis maidis* with the virus of streak.

Report of the Plant Pathologist. East African Res. Stat. Amani. Fifth Ann. Rpt. **1932–33**: 13–17, 1933.

This report is wholly on studies on the following virus diseases: Sugar-cane streak disease, tobacco and cassava mosaic.

Stormer, K[urt]

The dying of fruit trees and the leaf-roll disease of the potato. Jahresber. Ver. Angew. Bot. 7: 119–170, 1909.

Die Blattrollkrankheit der Kartoffel. (Leaf-roll disease of potato.) Ill. Landwirtschaftliche Zeitung. Jahrg. **30**(60): 565-566, 1910.

Plant diseases for the year 1909 of special notice. Landw. Wchnschr. Sachsen, **12**(2): 10–12, (3): 19–21, (4): 27–29, 1910.

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The leaf-roll disease of potatoes in Saxony. Naturw. Ztschr. Forst. u. Landw., **9**(12): 521–551, 1911.

Abban und wiederanffrischung von Kartoffelsorten durch Bodeneinflüsse. Ill. Landwirtschaftliche Zeitung. Jahrg. **51**: 177–179, 1911.

Stout, A[rlow] B[urdette]
Why we fail with garden lilies. Journ. New York Botanical Garden **28**: 285–296, 1927.
The author gives two pages to the importance of virus diseases.

Virus diseases of lilies in England. Garden Chron. **88**(2296): 532–533, 1930.
A survey of lilies infected with virus diseases and the insect vectors.

Stout, Gilbert L[eonidas]
A mosaic type in certain cases of peach yellows occurring near potatoes. Phytopathology (Abstract) **20**(1): 126, 1930.

The peach yellows situation in Illinois. U.S.D.A. Br. Plant Indus. Plant Disease Reporter **14**(4): 28–32, 1930. Mimeographed.)

Stover, W[ilmer] G[arfield]
Experiments with tomato streak. Phytopathology (Abstract) **18**(1): 154, 1928.

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Some experiments with a yellow mosaic of tomato. Phytopathology (Abstract) **23**(1): 34, 1933.

Stranviak, F[rantisvek]
La mosaicá virus de la Vigne. (The virus mosaic of the vine.) Second Intern. Congr. Path. Comp. (Paris) **1**: 367, 1931.

————————, **Blattny C[tibor Eugen Maria Karll], & Klecka, A.**
Mosaika revy vinne. (Predbezne). (Mosaic of the vine.) Préliminary report. Ochrana Rostlin, **11**: 89–98, 1931.
A description of disease which can be transmitted by grafting, by injection of juice of diseased plant and by *Lecanium corni.*

Strong, Richard P[earson] & Shattuck, G[eorge] C[heever]
Plant diseases. (The African Republic of Liberia and the Belgian Congo.) Contr. Dept Trop. Med. & Inst. Trop.. Biol. & Med. 5. (Harvard African Expedition 1926–27) p. 389–410, 1930.
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Plant lice transmit mosaic Potato Mag. **2**(6): 16, 1919.

Stucky, Henry Perkins
Plant diseases investigations of the Georgia Experiment Station. Georgia Sta. Rept. **1920**: 4–5, 1920.

Sturgis, W[illiam] C[odman]
Conn. Stat. Bul. **111**, 1892; **115**: 124, 1893.
Brief note describing peach yellows, important as an early record.

Preliminary notes on two diseases of tobacco. Connecticut Agric. Expt. Sta. Ann. Rpt. 1898, **22**: 242–260, 1899.
Gives description and results of studies. Believes the disease is physiological. Discusses the calico or mosaic of tobacco with reference to cause, soil, transmission and preventive measures. Also a spotting of tobacco which is probably the same as Iwanowski's "pockenkrankheit".

On the effects on tobacco, of shading and the application of lime. Connecticut Agric. Expt. Sta. Ann. Rpt. **23**: 252–261, 1899.

On the so-called "Grain" or wrapper tobacco. Connecticut Agric. Expt. Sta. Ann. Rpt. **23**: 262–264, 1900.

Summers, E. M.
Mosaic disease in Co. 281 cane. Sugar Bull **11**(23): 3–4, 1933. (Facts About Sugar (Abstract **28**(10): 398, 1933.)
Account of the occurrence of mosaic disease in Co. 281 cane in Louisiana.

Sundaranaman, S.

Mosaic disease of sugar cane in South India. Madras Agric. Dept. Bull. **92**: 5–13, 1928. (Rev. Appl. Mycol. **8**: 62, 1929.)

The result of studies on resistant varieties.

The "clump disease" of Ground-nuts. Madras Agric. Dept. Year Book, **1926**: 13–14, 1927.

Administration Report of the Government Mycologist, Coimbatore, for 1928–29. (Reprinted from Rpt. Dept. Agric. Madras Presidency, for the official year **1928–29**, p. 27, 1929.) (Rev. Appl. Mycol. **9**(2): 87–88, 1930.)

Contains a record of sugar-cane varieties resistant to mosaic.

Suzuki, U[metaro]

Report on investigations on the mulberry-dwarf trouble, a disease widely spread in Japan. Imp. Univ. Tokyo, Coll. of Agric. Bull. **4**(3): 167–226, 1900.

Chemische Physiologische Studien uber die Schrumpfkrankheit des Maulberrbaumeseines in Japan sehr weit verbeitete Krankheit Ztschr. Pflanzenkrank. **12**: 203–226, 258–278, 1902.

Swezy, Olive, & Severin, Henry H[erman] P[aul]

A filterable (Rickettsit-like) microorganism from *Eutettix tenella* and the sugar beet, both infected with curly top. Phytopathology (Abstract) **19**(12): 1143, 1929.

Factors influencing the minimum incubation periods of curly top in the beet leaf hopper. Phytopathology **20**(1): 93–100, 1930.

A study of the intestinal tract of *Eutettix tenellus*. Bacteria were found and evidence that the juice could be ojected from the oesophagus.

————, & Severin, H[enry] H[erman] P[aul]

A Ricktsia-like microorganism in *Eutettix tenellus* (Baker.) The carrier of curly top of sugar beets. Phytopathology **20** (2): 169–179, 1930.

The *E. tenellus* harbors two organisms which can not be separated on morphological grounds. One passes the filter and the other does not.

Swieten, H. J.

De tabaksteelt te Elst en omstreken in de Opper-Betuwe Tijdschrift ter bevordering van Nijverheid. Tweede reeks. **5**: 145–167, 1857.

Szembel, S[tefan Ju]

(A few notes on tomato diseases in the district of Astrakhan.) Comment Inst. Astrochanensis ad defensionem plantarum **2** (4) :32–34, 1930.

Brief notes on leaf curl, and mosaic are given; mosaic is transmitted according to the author's report by the mite *Tetrannychus telarius.*

(Prevalence of the chief diseases of cultivated plants in the district of Astrakhan during the period 1926 to 1929.) Comment Inst. Astrachanensis ad defensionem plantarum, **2**(4) : 61–80, 1930.

Brief notes on degeneration diseases of potato.

Takada, K[azuo]

Studies in the stripe leaf disease of barley. Journ. Tokyo Nogyo Daigaku (Tokyo Agric. Eoli.) **2**: 1–87, 1927.

Takahashi, W[illiam] N[oboru], & Rawlins T[homas] E[lsworth]

Electrophoresis of tobacco mosaic virus. Hilgardia **4**(15) : 441–463, 1930. (Phytopathology **30**(10) : 855, 1930.)

The authors give a review of the literature bearing on this phase of the subject and the results of their own experiments which they summarize as follows: Unpurified tobacco mosaic virus migrated to the anode during electrophoresis between pH 4 and pH 9. No migration of the virus was detected between pH 3 & 1.2.

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Method of determining shape of colloidal particles: application in study of tobacco mosaic virus. Proc. Expt. Biol. & Med. **30**: 155–157, 1932.

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Rod-shaped particles in tobacco mosaic demonstrated by stream double refraction. Science **77**(1934) : 26–27, 1933.

The authors give more details of their method and technique used in the demonstration by means of stream double refraction that the particles in the tobacco-mosaic virus are rod-shaped.

Stream double refraction exhibited by juice from both healthy and mosaic tobacco plants. Science n.s. **77**(1994) : 284, 1933.

Continuation of previous experiments. The observation of recent work showed that the juice from unfrozen healthy leaves exhibited marked stream double refraction. The phenomenon was not manifested by juice from unfrozen healthy tobacco leaves subjected to the treatment with safranin.

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Evidence regarding the shape of tobacco mosaic virus particle. Phytopathology (Abstract) **23**(1): 34–35, 1933.

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The virucidal action of high frequency sound radiation. Science N.S. **79**(2053): 415–416, 1934.

The author describes the procedure they followed in testing the effect of high frequency sound radiation on mosaic-tobacco leaves. The results obtained indicate that the tobacco mosaic virus is inactivated by high frequency sound radiation.

Takami, N.

(Stunt disease of rice and *Nephotettix apicolis.*) Journ. Agric. Soc. Japan **241**: 22–30, 1901.

Takimoto, S.

(On the mosaic disease of chinese cabbage and other crucifers.) Jap. Hort. **42**(6): 5–7, 1930.

Taubenhaus, J[acob] J[oseph]

The disease of the sweet pea. Delaware Agric. Expt. Sta. Bull. **106**: 93 p., 1914.

Reviews subject and gives first description of disease on sweet pea. Can be transmitted by needle puncture and aphids. Believes it is caused by bacteria or protozoa.

Sweet pea diseases and their control. Trans. Mass. Hort. Soc. 1916 Rpt. **1**: 131–143, 1916.

Taylor, G. M.

Degeneration of potatoes. Gard. Chron. **63**: 13, 1918.

Popular.

Taylor, W[illiam] A[lton]

The leaf-cut disorder of cotton seedlings. U.S.D.A. Ann. Rpt. **120** Br. of Plant Product. Rpt. for 1913 p. 16. 1913.

Tchirch, A.

Ueber Sereh, die wichtigste aller krankheiten des Zuckerrohres in Java Schwelz. Wochenschrift, f. Pharmazie **29**(6): 47–52, 1891.

Tedin, H.

Bladrollsjuka hos potatis. (Leaf roll of potatoes.) Sveriges Utsädesf. Tidskr. **1913**: 290–395, 1913.

Tehon, Leon R[oy], & Stout, G[ibert] L[eonidas]

Peach yellows in Illinois. Illinois State Nat. Hist. Surv. Bot. Cir. 1:23 p., 1929.

A report of survey work.

Observations on peach yellows in Illinois. Trans. Illinois State Hort. Soc. 1931. **75**:183–195, 1932.

Some historical data in regard to that disease stating that reliable reports indicate that it was observed as early as 1889. Considerations are given as to the spread and possible insect vector (*Myzus persicae*).

Tempany, H[arold]

Annual Report of the Department of Agric. Mauritius. 1921, 1922.

Reports on mosaic present.

————, Earle, F[ranklin] S[umner], & Brandes E[lmer] W[alker]

Mosaic disease in Natal. South African Sugar Journal **8**:269–271, 1924.

These authors have written independently giving their views on the mosaic situation in Natal based on the reports of H. H. Storey.

Teodoro, N. G., & Serrano, F[elicísimo] B.

Abaca heart rot and bunchy-top disease and their control, *Heterodera radicicola*. Philippine Agric. Rev. **19**:243–247, 1926.

Thatcher, R[oscoe] W[ilfred]

Raspberry mosaic. New York (Geneva) Agric. Expt. Sta. Ann. Rpt. **1922**, 41:51, 1923.

Brief notes.

Thompson, H[arry] S[tephen]

On the preventions of curl and dry-rot in potatoes. Journ. Royal Agric. Soc. England **6**:161–174, 1845.

Thornton, M. H., & Kraybill, H. R.

Further studies on a noninfectious leaf-deforming principle from mosaic tomato plants. Phytopathology (Abstract) **24** (1):19, 1934.

Thornberg, W[alter] S[trickland]

Western tomato blight. Better Fruit **6**:14, 1912.

Trupp, T[homas] C[yril]

The transmission of "Mosaic" disease in hops by means of grafting. Ann. Appl. Biol. **14**(2): 175–180, 1927.

A brief paper giving results of transmission by grafting.

Thung, T. H.

Physiologisch onderzoch met betrekking tot het virus der bladrolziekte van de aardappelplant, *Solanum tuberosum* L. (Physiological investigations in relation to the virus of potato leaf-roll diseases. (With English Summary.) Tijdschr. Plantenziekt. **34**(1–2): 1–74, 1928.

Studies which lead the author to believe the excess of starch in leaf-roll potato plants is due to disturbed translocation and not to disturbed enzymatic activity.

Over knolentingen die ter bestudeering der virusziekten van de aardappelplant worden mitgeverd. (On tuber-grafts made for studying potato virus diseases.) Tijdschr. Plantenziekten. **34**(7): 195–199, 1928.

The virus from a potato half tuber passed to a healthy half tuber without a union. The transmission is mechanical.

Smetstof en plantencel by enkele virusziekten van de Tabakplant. (Infectives principle and plant cell in some virus diseases of the tobacco plant.) Handelingen 6 *de* Nederl,—Ind. Nature wetensch. Congr. 1931. p. 450–463, 1932.

The author separated the active agent of the white or whitish yellow mosaic and common mosaic from a tobacco plant infected with both. He believes the former which is sporadic in Java, to be the same as Johnson's and McKinney's yellow mosaic. He is of the opinion that tobacco-mosaic virus is not a living agent but a dead toxic substance normally in the plant. This is in accordance with the theory advanced by Hunger in 1905.

De Kulr-an Kroepoek–Ziekten van Tabac en de corzaken van here verbreiding. (The curl and crinkle disease of tobacco and the causes of their dissemination.) Proefstat. vors-tenandsche Tobak. Meded. **72**: 1–54, 1932.

A virus disease that can be transmitted by grafting and the white fly (*Bemisia sp.*) The disease has been transmitted to tomato, *N. glauca* and *N. rustica*.

Bestrijding der Kurl-en Kroepoek-ziekte van tabak. (The control of the curl-and crikle diseases of tobacco.) Meded. Proefst. Vorstenl. Tabak Java **78**, 18 p. 1934. (English Summary p. 18.)

Tice, C[ecil]

Mosaic disease of potato. Agric. Journ. British Colombia. **7**: 77, 1922.

Leaf-roll disease of the irish potato. Agric. Journ. British Colombia. **7**: 10–11, 1922.

A popular discussion.

Tiedjens, V. A.

Yellow pickle in greenhouse cucumber. Massachusetts Agric. Expt. Sta. Bull. **225**, 8 p., 1925.

Tilford, P[aul] E[dward]

Potato Leaf-roll in Ohio. Ohio Agric. Expt. Sta. Bimonthly Bull. **11**(2): 55 59, 1926.

A general discussion and estimates of losses due to this disease.

Ohio potato disease. Ohio Agric. Expt. Sta. Bull. **432**. 38 p., 1929. (Rev. Appl. Mycol. **9**(1): 51. 1930.)

Brief notes. Popular.

Tims, E[ugene] C[hapel], & Edgerton, C[laude] W[ilbur]

Behavior of mosaic in certain sugar cane varieties in Louisiana. Amer. Journ. Bot. **18**(8): 649–657, 1931.

The field observations made by the authors led them to discuss the behavior of mosaic in certain sugar-cane varieties, mostly P. O. J. canes.

Tisdale, W[illiam] B[urleigh]

Tobacco disease investigations. Florida Sta. Rpt. **1922**: 128–139, 1922.

Plant pathology. Florida Agric. Expt. Sta. Rpt. **1929**: 68–81. 1929.

Record on spindle tuber of potatoes.

Tolaas, A. G.

The production of mosaic-free Triumphs. Amer. Potato Journ **3**(9): 301–302, 1926.

Popular.

Tollenaar, D[irk]

Jaarverslag Mei 1928–30 April, 1929. (Annual report, 1st May, 1928 to 30th April, 1929.) Proefstat. Vorstenlandsche Tabak, Meded, **62**, 55 p., 1929. (Rev. Appl. Mycol. **9**(2): 137–138, 1930.)

Contains some data on mosaic of tobacco.

Tomei, B[ertani]

Malattie delle Plante Erbacee. (Diseases of herbaceous plants.) Urbino, Italy p. 111, 1923.

Tompkins, C[hristian] M[ilton]

Effect of intermittent temperature on potato mosaic. Phytopathology (Abstract) **15**(1): 46, 1925.

Influence of the environment on potato mosaic symptoms. Phytopathology **16**(9): 581–610, 1926.

This paper gives the results of much valuable data obtained from experimental work under control conditions. The greater part of the work has to do with temperature.

Tower, W[inthrop] V[ose]

Mottling disease of sugar cane. Porto Rico Agric. Expt. Sta. Ann. Rpt. **1919**: 21–25, 1920.

Report of the Entomologist. Porto Rico Sta. Rpt. **1921**: 23–26, 1921.

Townley, John

The limited duration of varieties of potato, and progressive deterioration of the plant as a species, proved by a consideration of the curl, dry-rot, and other diseases. The diseases, Regeneration & Culture of the Potato. London, p. 67–85, 1847.

Of historical interest.

Townsend, C[harles] O[rrin]

Some diseases of sugar beet. U. S. D. A. Rpt. **72**: 90–101, 1902.

The curly top or western blight of the sugar beet. Science n.s. (Abstract) **23**(585): 426–427, 1906.

Curly-top, a disease of the sugar beet. U.S.D.A. Br. Plant Indus. Bull. **122**, 37 p., 1908.

Describes the symptoms and gives brief history. Gives a rather extensive discussion of possible causes.

Sugar beet mosaic. Science n.s. **42**(1076): 219–220, 1915. (Phytopathology (Abstract) **5**(4): 282, 1915.

An immune variety of cane. Science n. s. **49**(1272): 470–472, 1919. (Louisiana Planter & Sugar Manuf. **63**(3): 42, 1919. Sugar **21**: 305, 392, 1919.)

A discussion of the immunity of Kavangire cane to mosaic.

Disease immunity in beets. Facts About Sugar **22**(33): 789, 1927.

Popular.

Townsend, C[harles] H[enry] T[yler]

Notas sobre *Aphis maidis* (Notes on *Aphis maidis*.) Estac. Expt. Agric. Soc. Agri. (Perú) Circ. **5**. 10 p., 1928.

Trabut

Sur la chlorose infectiouse des citrus. (Infectious chlorosis of citrus.) Compt. Rend. Acad. Sci. Paris. **156**: 243–244, 1913.

Treub, M.

Onderzoekingen over serehziek suikerriet. Meded. uit ' S Lande Plantentuin **2**, 1885.

Trochain, J.

La lepre de l' arachide en Senegal. (Leprosy of ground nut in Senegal.) Rev. de Bot. Appli. et d' Agri. Trop. **11**(117): 330–334, 1931.

Trotter, Alessandro

Nostre conoscenze sulle virosi del tabacco ed in particolare sul "mosaico". (Our knowledge on virosis of tobacco in particular to the "mosaic".) Boll. Tecn. R. Inst. Sperim. per le Cultizazione del Tabacchi "Leonardo Angeloni" Scafati **30**(2): 81–104, 1933.

Troude, M. J.

La jaunisse de la betterave. (The yellows of the beet.) La Sucrerie Indigége et Coloniale. **48**: 338–340, 1896.

True, R[odney] H[oward], Black, Otis Fisher, Kelly, James W[illiam] Bunzel, Herbert H[orace], Hawkins, Lon A[drian] Jodidi, Samuel Lee, & Kellogg, Edward H.

Physiological studies of normal and blighted spinach. Journ. Agric. Res. **15**(7): 369–408, 1818.

This general title includes four papers as follows: I. True, Black and Kelley. Ash content in normal and in blighted spinach. Gives the results of chemical studies. II. Bunzell, H. H. Oxidase reaction in healthy and in blighted spinach. A greater oxidase activity in diseased than in healthy plants but does not determine whether it is a cause or a symptom.

This is believed to be the same as rosette. The plants are dwarfed and sometimes completely sterile. III. True and Hawkins: Carbohydrate production in healthy and in blighted spinach. Carbohydrate accumulation greater in diseased than in healthy plants. IV. Jodidi, Kellogg and True: Nitrogen metabolism in normal and in blighted spinach. Gives the results of studies made to determine reasons for the results obtained in paper No. III.

-------------, & **Hawkins, Lon A[drian]**

Carbohydrate production in healthy and blighted spinach. Journ. Agric. Res. **15**: 381–384, 1918.

Tsen-Cheng.

Sur les modifications histologiques constactées chez la pomme de terre. (*Solanum tuberosum*) atteinte de dégénérescence (Maladie de l' enroulement.) (Histologic modifications of potatoes attacked by leaf roll.) Compt. Rend. Sci. (Paris) **186**(8): 524–526, 1928.

Histological studies on the leaves.

Sur les phénoménes de nécrose dans la pomme de terre atteinte de la maladie de l' enroulement. (Necrosis in potatoes attacked by leaf roll.) Compt. Rend. Acad. Sci. (Paris) **186** (11): 712–714. 1928.

The author discusses the process of phloem necrosis in diseased plants.

Recherches sur la maladie de dégénérescence (enroulement) chez *Solanum tuberosum*. (Researches on leaf roll disease of potato. *Solanum tuberosum*. 103 p., Jouve édit., 15 me Racine: Paris. Thése, Fac. Sci. Paris. **111** p., 1929.)

Tsienen, S. J.

Recherches sur l' histologie des plantes panachées et sur le mecanisme cytologique de la panachure. (Investigations on the histology of variegated plants and the cytological mechanism of the variegation.) Thesis. Fact. Sci. Nancy (France) 104 p., n.d.

Tsuji, R.

(The curly dwarf of potato.) Horticulture **11**: 35–39, 1919.

Turner, W[illiam] F.

Progress in phony peach disease eradication. Journ. Econ. Entom. **26**(3) : 659–667, 1933.

Report of work done.

Unite, J[uan] O., & Capinpin, J[osé] M[ananjaya]

Selection of mosaic-free cuttings of sugar cane. Philippine Agric. **15**(2) : 67–73. 1926. (The Planter & Sugar Manuf. **77**(8) : 147–148, 1926.)

Uphof, J[ohannes] C[ornelis] T[heodorus]

Eine neus Krankheit von *Cephalanthus occidentalis.* (A new disease of *Cephalanthus occidentalis.*) Zeitschr. fur Pflanzenkr. **31**(3–4) : 100–108, 1921.

Uppal, B[adri] N[ath]

India: mosaic disease of chillies (*Capsicum annuum.*) in the Bombay Presidency. Internat. Bull. of Plant Protec. **3**(7) : 99, 1929. (Rev. Appl. Mycol. **9**(1) : 10, 1930. Int. Anz. Pflanzenschutz **3** : 103, 1929.)

A record of heavy losses.

India: A new virus disease of *Dolichos biflorus.* Internat. Bull. Plant Proct. **5**(9) : 163, 1931.

A disease very similar to mosaic of beans occur on *Dolichos biflorum* and *D. lablab.*

Utra, Gustavo d'

A molestia do "mosaico" de fumo (Mosaic disease of tobacco) Bol. Agric. Sao Paulo (Brasil) **5**(2) : 51–71, 1904.

Uzel, H[einrich]

Mitteilung uber Krankheiten und Feinde der Zuckerrübe in Bohmen in Jahre. 1907 und der mit derselben abwechselnd pultivieten Pflanzen. Zeitschr. f. zuckerindus. in Böhmen **33** : 357, 1909. (Rev. Centralbl. f. Bakt. **24**; 207–271, 1909.)

Valeton, T.

Bijdrage tot de kennis der serehziekte. Proefst. Oost–Java, Batavia p. 307–338, 1891.

Valle Zeno, Rafael del

Mottling or yellow stripe disease of sugar cane. Some facts relative to the importance of the discovery of the "morbid" cause. Published privately with 2 color plates by author, New York, 1919.

Gives symtoms and effect of the disease. Claims to have discovered the great secrets of cause and control.

Valleau, W[illiam] D[orney], & Johnson, E[dward] M[arshall]

The relation of nitrates to tobacco frenching. Science. n.s. **64**: 278–279, 1926.

Frenching which was for a time considered the same as mosaic is caused by soil conditions. It is not infectious.

Commercial tobacco and cured leaf as a source of mosaic disease in tobacco. Phytopathology **17**(8): 513–522, 1927. (Trop. Agric. (Trinidad) **4**: 135, 1127.)

The virus from dry tobacco 16–31 years old was active when inoculated into growing plants. The disease was reduced by having the laborers use steam sterilized tobacco.

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The effect of a strain of tobacco on the yield and quality of burley leaf tobacco. Phytopathology **17**(8): 523–528, 1927.

Losses due to the disease. The author reports two types of mosaic and gives the results of field studies on losses.

Tobacco frenching—A nitrogen deficiency disease. Kentucky Agric. Expt. Sta. Bull. **281**, 1927.

This disease is frequently mistaken for mosaic.

Observations and experiments on the control of true tobacco mosaic. Kentucky Agric. Expt. Sta. Bull. **280**: 145–174, 1927.

The disease is found in the seed beds. It overwinter in horsenettles, ground cherries and in cured tobacco. It is transmitted by the men chewing diseased tobacco and spitting in the seed beds.

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Some virus diseases of tobacco in Kentucky. Phytopathology (Abstract) **18**(1): 132–133, 1928.

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Weed control and the potato virus problem. Amer. Potato Journ. **5**(9): 257–259, 1928.

Experiments and observations on the control of true tobacco mosaic. Phytopathology (Abstract) **18**(1): 132, 1928.

Peach yellows and potatoes. Plant Disease Reporter **12**(9): 102–103, 1928.

Brief mimeograph note giving the relation of peach yellows and potato virus diseases.

Tobacco mosaic control in Mexico. Phytopathology **19**(9): 880, 1929.

The author believes that bulk heating inactivates the virus.

The viruses concerned in rugose mosaic of Irish Cobbler potatoes and the weed host problem. Phytopathology (Abstract) **20**(1): 135, 1930.

---------, & **Johnson, E[dward] M[arshall]**

The relation of some tobacco viruses to potato degeneration. Kentucky Agric. Expt. Sta. Bull. **309**: 475–507, 1930.

The authors give the result of a large number of inoculations and descriptions of the symptoms of virus disease which may be summarized as follows: 1.—A description of a tobacco disease called veinbanding. 2.—Irish Cobbler potato plants healthy or diseased, appear to always possess a virus which produces necrotic and chlorotic ring and line patterns, in tobacco. 3.—The mosaic virus and interveinal mosaic virus from Irish Cobbler potatoes, and rugose mosaic virus from Green mountain potatoes produces spot necrosis in tobacco. 4.—A mixture of healthy potato and veinbanding viruses produced a spot necrosis in tobacco which is the same as that produced by the rugose mosaic virus of potatoes. 5.—Cucumber mosaic virus causes a mosaic in potatoes. There appears to be three strains. 6.—Ringspot virus of tobacco is different from the necrotic ring produced by healthy potato virus. 7.—Three strains of each virus produce a rugose mosaic. 8.—Viruses from weeds appear to be important factors. 9.—*Myzus persicae* rarely if ever transmitted healthy potato virus.

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Some possible causes of streak in tomatoes. Phytopathology **20**(10): 831–839, 1930.

A study of tomato streak and tobacco mosaic diseases.

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The viruses concerned in a natural epiphytotic of streak in tomatoes. Phytopathology **21**(11): 1087–1089, 1931.

A brief paper on an outbreak of tomato streak in the greenhouse. The author concludes experiments which demonstrated that the streak in tomatoes and necrotic mosaic in tobacco resulted from a mixture of tobacco and potato.

A virus disease of plum and peach. Kentucky Agric. Expt. Sta. Bull. **327**: 89–123, 1932.

The author describes and discusses a virus disease of plum and peach. Gives the history of the disease, budding experiments, discusses the patterns and plum virus; spread of the virus budded trees and the spread of similar virus diseases of the apple and rose. At the end gives suggestions for eradication of the virus.

Seed transmission and sterility studies of two strains of tobacco ringspot. Kentucky Agric Expt. Sta. Bull. **327**: 43–80, 1932.

The most severe disease in Kentucky. There are two types, the green and the yellow. The yellow is distinct from the Aucuba mosaic of potato. Both are carried in the seed Ring spot has been reported on Jimson, cantaloupe. Petunia, sweet clover, *Physalis* sp., *Solanum carolinensis* and cucumber The pods produce a small number of seed and the pollen grains are smaller than normal

A virus disease of *Delphinium* and tobacco Kentucky Agric. Expt. Sta Res Bull. **327** 81–88, 1932.

The author reports a virus disease on the garden varieties of *Delphinium* transferable to tobacco He also states that the virus under study appears to affect plants in 3 families, *Ranunculaceae, Solanaceae* and *Cucurbitaceae* and in 2 orders, *Ranunculales* and *Campanulales* of the flowering plants

Two seed transmitted ring-spot diseases of tobacco. Phytopathology **22**(1) 29, 1932

Two ring spot diseases, (*a*) green patterns, (*b*) green & yellow. Both are transmitted by the seed

------------, & Johnson, E[dward] M[arshall]

Tobacco diseases in Kentucky Kentucky Agric. Expt. Sta. Bull **328** 109–154, 1932.

A popular publication giving descriptions of the common diseases, including the most common virus diseases.

Vanha, J. V.

Die Krausel-oder Hollkrankheit der Kartoffel, ihre Ursache und Bekampfung. Monatschefte fur Landwirtschaft, Jahrg. **3**(9) · 268, 1910.

Venkata Rao, M. G.

A preliminary note on the leaf curl mosaic disease of Sandal. Indian Forester **49**(12): 772–777, 1933.

Description of this new disease of *Santalum album* reported from Mysore (India) which the author named "leaf-curl mosaic". Transmissibility studies were conducted which the author describes. The author found that leaf-curl mosaic spreads more rapidly than spike.

Vanterpool, T[homas] C[lifford]

The stripe or streak disease of tomato in Quebec. Quebec Soc. Protect. Plants. Ann. Rpt. 1923–24, **16**: 116–123, 1924.

A description of the disease.

Streak or winter blight of tomato in Quebec. Phytopathology **16**(5): 311–331, 1926.

A report of studies which show that this disease is caused by a virus.

Varadaraja Iyengar, A. V.

Contribution to the study of spike-disease of sandal (*Santalum album* Linn). II Journ. Indian Inst. Sci. Ser **A. 11**: 97–109, 1928.

Contribution to the study of spike-disease of sandal (Santalum *album* L.). Part XV. The role of plant acids in health and disease. (n. d.).

Leaves from healthy plants contain more malic and oxalic acids than those from diseased plants. The reverse is true for succinic acid. The diseased plants contain more phosphates than the healthy plants. Carbon dioxide production is greater for diseased than healthy plants. The reverse is true for shoots that have been cut from the plant.

Vasters, J.

Untersuchungen uber Blattroll-und mosaikkrankheit der Kartoffel. (Investigations on leaf roll and mosaic disease of potatoes. Pflanzenbau, **4**: 211–21) 1928.

Vaughan, E. K.

Transmission of the crinkle disease of strawberry. Phytopathology **23**(9): 738–740, 1933.

Report of studies of the Oregon Agricultural Experiment Station to determine the nature of the infective principle in strawberry crinkle and its mode of transmission.

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A criticism of Hole's paper in Indian Forester 43: 430–448 (1917). Gives evidence that the disease is not caused by fire and not due to unbalanced circulation of sap.

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Report of the Government Sugar-Cane Expt. Sta. Sci. Rpt. Agric. Res. Inst. Pusa **1924–25**: 142–151, 1925. (Rev. Appl. Mycol. **5**: 251, 1925.)

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The authors advance the theory that numerous trichomes which protect the leaves from the insect vectors are factors in resistance.

Verhoeven, W[ilhelm] B[oudewijn] L[eenwenburg]
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A propos des maladies de dégéréscence de la pomme de terre. (About the disease of degeneration of the potato.) Ann. Gembloux, Brussel **33**: 443–449, 1927.

Quelques données nouvelles sur les maladies á virus filtrants. (Some new data about the filterable virus diseases.) Ann. Gembloux, Brussel **34**: 121–135, 1928.

Les maladies á virus filtrants de la Betterave. (Beet disease caused by filterable viruses.) La Sucrerie Belge **49**(7): 121–127, 1929. (Rev. Appl. Mycol. **9**: 355, 1930.)

List of three virus diseases of sugar beet. 1.—Curly top carried by *Eutettix tenella.* 2.—A similar disease in Czechoslovakia which is supposed to be transmitted by *Cicadula sexnotata* and 3.—A similar disease in Belgium which is supposed to be transmitted by *Myzus persicae.*

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Experiences sur la transmission des maladies de dégénérescence de la pomme de terre. (Experiences on the transmission of the diseases of the degeneration of the potato.) Ann. Gembloux **39**(1): 12–23, 1933.

Description of result obtained in experiments on virus diseases of potatoes.

Hotes nouveaux des maladies & virus filtrants de la Betterave. (New hosts of the beetroot diseases due to filterable viruses.) Bull. Soc. Roy. Bot. Belg. ser. 2 **15**(2): 137–147, 1933.

Report of the author's cross-inoculation experiments with yellows and mosaic viruses of beet on 60 plants, most of which are common weeds.

Étude comparative de pommes de terre d' origines diverses. II. Résultats des expériences faites en 1932. (Comparative studies of potatoes of different origines. II. Results of Experiments done in 1932.) Bull. Inst. Agron. & Stat. Rech. de Gembloux **2**(1): 45–73, 1933.

The degeneration diseases present were leaf roll, mottling, mild mosaic, rugose mosaic, crinkle mosaic, aucuba mosaic and streak. Results of studies are given in full details and tabular form.

Les viroses de la betterave. (The viroses of the beet.) Sucrerie Belge, **53**(1): 2–10, 1933.

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Losses caused by mosaic in H–109 plant cane. The Hawaiian Plant. Rec. **33**(3): 362, 1926.

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Two diseases of the tomato mosaic and early blight. Farming So. Africa, **3**: 1167–1169, 1928.

On two cases of recovery from a mosaic disease tomato plants *Lycopersicum esculentum*. Ann. Appl. Biol. **16**(1): 34–39, 1929.

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The eradication of sugar cane mosaic in Fajardo. Puerto Rico Ins. Expt. Sta.. Circ. **33**: 52–55, 1920.

La represión del matizado en Fajardo. (Mosaic eradication in Fajardo.) Rev. Azucarera & Agric. Puerto Rico **1**: 96–98, 1921.

The efficiency of "roguing" method for the eradication of mottling disease. Louisiana Planter **69**(2): 30, 1922.
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Observations relatives a L' influence qu' exerce la greffe sur le sujet. (Observations about the influence that the graft exercise on the stock.) Journ. Soc. Imp. & Cent. Hort. (France) **9**: 144–145, 1863.
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El mosaico de la caña de azúcar. (Mosaic of sugar Cane.) Tipografía Cervantes, San P. de Macorís, Dominican Rep. 44 p. (Facts About Sugar **26**: 503, 1931.)
A popular textbook.

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Mosaic-immune variety of sugar-cane. Sugar **5**: 345, 1923.

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(Filterable virus) Ztschr, Infektionskrank, u. Hyg. Haustiers, **9**(6): 433–479, 1911.

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Potato breeding problems. Proc. 16th Ann. Meeting Potato Assoc. America. **1929–30**: 63–69, 1930. (Rev. Appl. Mycol. **9**: 550, 1930.)
Results of efforts to develop a variety free from mosaic.

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Precipitation of the virus of tobacco mosaic. Science n.s. **66** (1711): 357–358, 1927.

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Mosaic disease of tobacco. 1—Progress in freeing the virus of accompanying solids. Bot. Gaz. **87**(1): 14–38, 1929. (Contr. Boyce Thompson Inst. **1**: 479–503, 1929.)

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Comparison of juice from diseased and healthy tobacco plants. Phytopathology (Abstract) **22**(1): 29, 1932.

Decomposition of the safranin precipitate of mosaic virus of tobacco. Phytopathology (Abstract) **22**(1): 29, 1932.

Mosaic diseases of tobacco: 5—Decomposition of the safranin-virus precipitate. Phytopathology **22**(12): 965–975, 1932.

This paper gives the results of experimental studies for securing a rapid method for the purification of virus preparation.

Virus diseases of plants. Missouri Agric. Expt. Sta. Bull. **310**: 41, 1932.

Brief notes on experimental work in progress to determine the nature of the virus of solanaceous plants.

Further purification of the virus of tobacco mosaic. Phytopathology (Abstract) **23**(1): 35, 1933.

Purification of the virus of tobacco mosaic. Phytopathology (Abstract) **24**(1): 20, 1934.

Possible chemical nature of tobacco mosaic virus. Science n.s. **79**(2059): 548–549, 1934.

Brief article, discussing, Lojkin and Vinson, Barton-Wright and Mc Bain, and Caldwell's previous work on the subject. Comparison of results obtained under each condition.

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Ueber die keimung der kartoffelknollen. Bot. Ztg. 1, **60**: 87–114, 1902.

Vogel, Irving Henry

Leaf-roll and mosaic of potatoes. Proc. New York State Potato Assoc. p. 21–24, 1918.

Voges, E[rnst]

(The history of potato leaf-roll.) Fühling's Landw. Ztg. **61** (16): 542–552, 1912.

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Das diesjährige starke Auftreten des Mosaikkrankheit (Gelbflegheit) des Sinates. (The current year's widespread occurrence of mosaic disease (Yellow spotting) of spinach.) Inst. fur Pflanzenkrankh. der Landw. Hochschule. Bonn. Poppelsdorf. 3 p., 1929. (Rev. Appl. Mycol. **9**: 428, 1930.)

A severe outbreak of mosaic on spinach. The disease is transmitted by *Macrosiphum pisi, Aphis fabae, (A, runisit) Mysoides (Myzus) persicae.*)

Einflüsse des Bodens, der Luft des Lichtes auf die Empfanglichkeit der Pflänzen fur krankheiten. Phytopath. Zietschrift. **3**(1): 9–16, 1931.

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Abvan und Viruskrankheiten. (Degeneration and virus diseases.) Land. Vorträge 55 p., 1933.

Discussion of the ecological theory of degeneration of potato with special reference to H. Morstatt, Merkenschlager and other hypothesis. The author declares that potato degeneration as observed in Switzerland is entirely to be attributed to the influence of virus diseases.

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Variétés de Pomme de terre susceptibles d'être cultivés avec succés en des altitudes entre 1,000 et 2,000 metres. (Potato

varieties susceptible of being cultivated with success at an altitude between 1,000 and 2,000 meters.) Comptes Rendus Acad-Agric. France **15**(21): 763–765, 1929.

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Bericht über die Tätigkeit der Budensanstalt für Pflanzenschultz in Wien in den Jahren 1921 bis 1923. (Report on the Federal Institude for Plant Protection in Vienna during the year 1921 to 1923.) Ztchrs. Landw. Ver. in Deutsch-Ostr. p. 48, 1924.

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Peach yellows and frost injury. Science n.s. **31**(803): 798–799, 1910.

Brief but very comprehensive note defining these two troubles of frequent confusions.

The peach yellows group of peach disease. Calif. Dept. Agr. Mo. Bull. **19**(7): 484–488, 1930.

Brief popular description of peach yellows, peach rosette, little peach and phony peach disease.

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Mosaic disease of cane. Sugar, **23**: 500–501, 1921.

Mosaic disease of plants. West Indian Bull. **18**: 197–206, 1921.

Wakker, Jan H[endrik]

Gele Strepenziekte. (Yellow stripe disease.) Archief voor de Java Suikerind, **1**: 4, 1894.

Die indirecte Bekämpfung der Serehkrankheit des Zuckerrohres auf Java. **66**: 1–7, 1896.

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(A review of the diseases of the sugar-cane in Java, I.) Med. Proefsta. East Java. N. Ser. No. **22**, p. 11, 1896.

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De Ziekten van het Suikerriet op Java. (Sugar cane disease in Java.) Leiden. p. 166–169, 1898.

Walbach, S[imeon] B[urt]

The filterable virus summary. Journ. Med. Res. **27**(1): 1–25, 1912.

Waldmann, O. Pyl, G.

Über unsishtbare krankheitserreger. 1—Der Stand der Virusfoschung. 2—Über die moghichkeit einer chemischen Bearbeitung des Virus problems. 3—Die Kunsthche Vermechrung netravisibler Krankheitserreger. Naturwissenschaften **20**: 129–134, 150–153, 1932.

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Physalis and cucurbit mosaic intertransmissible. Phytopathology (Abstract) **14**(1): 56, 1924.

The mosaic disease of *Nicotiana glutinosum* not distinct from tobacco mosaic. Phytopathology (Abstract) **14**(1): 57, 1924.

Studies on the mosaic disease of *Nicotiana glutinosa*. Phytopathology **15**(9): 542–543, 1925.

The author gives a brief review of the literature and results of inoculation work. He says: "The mosaic disease on tobacco is transmissible to *N. glutinosa* and the mosaic disease on *N. glutinosa* is transmissible to tobacco". Tomatoes are susceptible to the same disease.

The Relation of Certain species o. *Physalis* to overwintering of the mosaic diseases of cucumber. Phytopathology **15**(12): 733–744, 1925.

The author gives evidence that the cucumber virus overwinters in Physalis pubescens. He transmitted the disease by inoculation to *P. subglabrata* and *P. heterophylla*.

A comparative study of the mosaic disease of cucumber. Tomato and Physalis. Phytopathology **16**(7): 431–458, 1926.

A study in the variations of the reactions of host plants to extracts from different mosaic plants.

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Certain grass hosts of the corn aphid considered in relation to their occurrence in Cuba. Trop. Plant Res. Foundation Bull. **5**: 3–14, 1926. (Rev. Appl. Mycol. **5**: 318, 1926. Rev. Appl. Ent. Ser. A. **15**: 379, 1926.)

This paper gives the results of studies of sugar cane mosaic on other hosts.

Walker, M. N.

Occurrence of watermelon mosaic. Phytopathology **23**(9): 741–744, 1933.

Report of the occurrence of watermelon mosaic in Florida. The writer gives a description of the disease and its behaviour. *Aphis gossypii* appears to be the possible insect vector. This is apparently the first record of the spontaneous occurrence of mosaic in watermelons.

Wallace, G. B.

Report of the Mycologist. Tanganyika Territory Dept. Agr. Ann. Rpt. **1932**: 76–80, 1933.

The author reports that the most destructive disease of sesame is a leaf curl probably caused by a virus.

Wallman, F.

Bacteriophagie et processus similares mosaïque des plantes. (Bacteriophage and similar processes mosaic diseases of plants.) Bull. Inst. Pasteur **26**(1): 1–14, 1928.

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Chlorosis yellowing of plants; cause and control. Utah Expt. Sta. Circ. **85**, 11 p. 1930.

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Biochemical changes accompanying curly top of tomatoes. Phytopathology (Abstract) **23**(11): 929, 1933.

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Witches' broom on the locust. Plant World **1**: 83–84, 1898.

Watson, H. E. et al

Proceedings of the conference on the spike-disease of sandal held at 11 A. M. on Monday, the 7th July, 1930 at the Indian Institute of Science, Bangalore, Indian Forester **57**(5): 215–233, 1931.

Reports of many investigators of the studies on various phases of this virus disease.

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Investigations of "bunchy top" disease of bananas. Queensland Agric. Journ. **21**(4): 263–275, 1924.

A very comprehensive paper on our knowledge of the disease up to that time.

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Particle size of the virus of tobacco in purified solutions. Phytopathology (Abstract) **22**(1): 29, 1932.

Webb, R[obert] W[illiam], Leighty, C[lyde Evert], Dungan G[eorge] H[arlan], & Kendrick J[ames] B[lain]

Varietal resistance in winter wheat to the rosette disease. Journ. Agric. Res. **26**(6): 261–270, 1923.

The results of studies showing that this disease can be controlled by the use of resistant varieties.

Certain factors influencing the development of the mosaic disease of winter wheat. Phytopathology (Abstract) **17**(1): 41, 1927.

Soil factors influencing the development of the mosaic disease in winter wheat. Journ. Agric. Res. **35**(7): 587–614, 1927.

This paper gives the effect of temperature and moisture on the development of both the host and the disease.

Further studies on the soil relationships of the mosaic disease of winter wheat. Journ. Agric. Res. **36**(1): 53–76, 1928.

This paper gives the results of studies showing that the active agents exist in the soil.

Weber, G[eorge] F[rederick]

Mosaic disease of sweet potato. Phytopathology (Abstract) **13**(1): 42–43, 1923.

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Diseases of sweet potatoes in Florida. Florida Agric. Expt. Sta. Bull. **212**, 40 p., 1930.

Popular notes given sweet potato mosaic diseases.

Mosaic disease of vegetable plants. Florida Agric. Expt. Sta. Press. Bull. **446**, 2 p., 1932.

Popular.

Wedkeworth, H[erman] H[amilton], & Anders, C. B.

Value of certified Irish potato seed in Mississippi. (Mosaic) Mississippi Agric. Expt. Sta. Circ. **60**, 4 p., 1925.

Popular, contains data on yield.

Effect of mosaic on sweet potato yields. Missouri State Plant Bd. Quart. Bull. **6**(3): 11–12, 1926.

Degeneration diseases of the irish potato in Mississippi. Mississippi Agric. Expt. Sta. Bull. **258**. 11 p. 1928.

The author gives a description of mosaic, leafroll and spindle tuber. Also the effects on production and method of control by the use of certified seed.

Weimer, J[ames] L[e Roy]

Further evidence of the non-transmissibility of the so-called sweet potato mosaic. Phytopathology (Abstract) **16**(1): 74, 1926.

Alfalfa mosaic. Phytopathology (Abstract) **21**(1): 122–123, 1931.

Studies on alfalfa mosaic. Phytopathology **24**(3): 239–247, 1934.

Description of a transmissible virus disease of alfalfa, of the mosaic type. The insect vector used in transmitting the disease was the pea aphid.

Weiss, F[reeman] A[lbert]

A summary of the important contributions to potato pathology, which have appeared in foreign periodical literature in the past year. Potato Assn. Amer. Proc. **14**: 215, 218–225, 1927.

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Pacific Coast survey for rose mosaic. U.S.D.A. Plant Disease Reporter **14**(20): 203–205, 1930. (Mimeographed).

Wellensiek, S[usan] J[acobus]

Met een Hollandew samenvatting de physiologie der knolvorming bij de aardapple. (The physiology of tuber-formation in the potato plant.) Overgedrukt uit de Mededeelingen van de Land Bouwhoogeschool. Deel **33**, 1929.

The author planted tubers in wet sand and kept them in the dark. The sprouts were removed as soon as formed. The author describes seven types of tuber formation as follows,—(1) Normal tuber-formation.—(2) aerial tuber-formation,—(3) tuber formation during storage in the light,—(4) tuber formation during the storage in the dark,—(5) tuber-formation on dried mother tubers,—(6) premature tuber-formation after planting,—(7) Oortwijin Botje's case of tuber-formation are compared as to their mode of origin, they all can be ascribed to an increase of the concentration of food-substances. However, this increase may be directly due to photosynthesis (above types 1, 2, and perhaps 3), indirect absolute due to loss of water (types 4, 5 and 6, probably also type 3) or indirect relatively due to loss of a certain substance (type 7).

De invlved van poottijd en rijafstand op de verspreiding van Aardappelvirosen. (The influence of planting time and row distance on the spread of potato viruses.) Landbonwkundig

Tijdschr., **41** (497) : 641–648, 1929. (Rev. Appl. Mycol. **9** : **331**, 1930.)

The results are tabulated and gives much valuable information.

Wallington, R[ichard]

Degeneracy of the potato. Rpt. Second, Ann. Meeting Minnesota Potato Growers Ass'n, 1917.

The uselessness of hill selection under conditions where rapid degeneration or running-out is prevalent. Proc. Amer. Sci. **1919** : 175–179, 1920.

Wellman, F. L.

Control of celery mosaic by eradicating of the wild host *Commelina nudiflora*. Phytopathology, **22**(1) : 30, 1932. Science **76** : 390–391, 1932.)

The disease is not carried in the seeds but persists in *C. nudiflora*. The vector is *Aphis gossyppi*.

Wennink, C. S.

De gevolgen der bladrolziekte bij aardappelen. (Control of leaf-roll of potatoes.) Tijdschr. Plantenz. **24**(1) : 1-4, 1918.

The results of experiments which support Quanjer's statement that disease-free potatoes can be produced by seed selections and growing in non-infested soil.

Went, F[riedich] A[ugust] F[erdinand] C[hristian]

De serehziekte. Arch. Java–Suikerind. **1** : 425–472, 1893.

De serehziekte. In Wakker en Went. De ziekten van het Suikerriet of Java p. 76–98, 1898.

Werner, H[arvey] O[scar], & Howard R[obert] F[rancis]

Seed potato investigations. Nebraska Agric. Expt. Sta. Res. Bull. **24**, 58 p., 1923.

Field studies on the effects of degeneration diseases and methods of control.

Spindle-tuber, the cause of "run out" potatoes. Nebraska Potato Imp. Assoc. Ann. Rpt. **6** : 57–79, 1924.

Relation of environment to spindle-tuber symptoms. Proc. 1924 Ann. Meeting Potato Ass'n Amer. **11** : 102–106, 1925.

A discussion of facts brought out as a result of field experiments.

The spindle-tuber disease. On cause of "run-out" of seed potatoes. Nebraska Agric. Expt. Sta. Bull. **207**, 21 p., 1925.

This paper gives the distribution of the disease, its effect on yield and quality, symptoms, transmission, rate of increase and methods of control.

The spindle-tuber disease as a factor in seed potato production. Nebraska Agric. Expt. Sta. Res. Bull. **32**: 4–128, 1926.

A very extensive paper giving symptoms, commercial consideration, geographical distribution, influence of enviroment and transmission.

Identifying spindle tuber in the field. Amer. Potato Journ.. **4**(8): 89, 90, 1927.

Relation of time of roguing to the spread of spindle tuber in seed potato plants. Phytopathology **19**(11): 1045–1049, 1929. (Rev. Appl. Mycol. **9**: 263, 1930.)

A discussion of control by roguing.

Effect of variable conditions within a field containing spindle tuber plants upon the seed value of the potatoes produced. Amer. Potato Journ. **6**(6): 168–170, 1929.

Werth, E[mil]

Zur Klimatologye, Pflanzengeographie und Geschichte des Europaischen Ackerbanes. (On the climatology, plant geography and history of european agriculture.) Ber. d. Deutsch. Bot. Gesell, **47**: 34, 1929.

Wessels, P[hilip] H[enry], & Hartwell, B[urt] L[aws]

Viability and composition of "seed" potatoes as affected by climatic conditions and by various other factors. Journ. Amer. Soc. Agron. **19**: 761–780, 1927.

This paper contains some data on the "running out" or "deterioration" of potatoes.

Westerdijk, Johanna

Die Mosaikkrankheit der Tomaten. (Mosaic diseases of tomato.) Meded. Phytopath. Lab. Willie Commelin Scholten, Amsterdam, **1**: 1–20, 1910.

Gives results of studies on heredity, light and transmission. Could not infect tobacco with tomato mosaic or tomato with tobacco mosaic. Carried in the seed.

Die mosaikkrankheit der kartoffelplanze. (Mosaic disease of the potato plant.) Jahresbericht de verreiningung für angewandte Botanik **14**: 145–149, 1916.

Weston, William H[enry] Jr.

Report on the plant disease situation in Guam. Guam Agric. Expt. Sta. Report **1917**: 45–62, 1918.

Reported a yellowing and dwarfing of corn.

Whetzel, H[erbert] H[ice]

Report of the pathologist for the period June 10 to Dec. 1921, pp. 30–64. Bermuda, Bd. and Dept. Agric. Reports. **1921**: 30–64, 1922.

The seed potato situation. Bermuda Dept. Agric. Bull. **1922**: 2–4, 1922.

Whipple, Orville B[laine]

Degeneration in potatoes. Montana Agric. Expt. Sta. Bull. **130**, 29 p., 1919.

Popular discussion. Gives the result of five years' field studies on these diseases.

White, Richard P[eregrine]

• An infectious chlorosis of roses. U.S.D.A. Plant Diseases Reporter **12**(4): 33–34, 1928.

Early record and description of the disease.

Field control of rose diseases. Phytopathology (Abstract) **20**(1): 130–131, 1930.

(Diseases of the following ornamental plants: China aster. *Delphinium* or larkspur, iris, peonias, roses, sweet peas and tulips. New Jersey Agric. Expt. Sta. Circ. Nos. **234, 237, 239, 241, 243** & **244**, 1931.

Popular notes on virus diseases of these plants.

Chlorose of the rose. Phytopathology, **22**(1): 53–69, 1932.

The author describes different types of chlorosis with special attention to the virus type which attacks *Rosa manetti*, *R. multiflora* *R. odorata* and some varieties.

Whitehead, T[athan]

A possible cause of "spike" in sandal. Indian For. **42**: 247, 1916.

Leaf curl and mosaic of potatoes and their relation to deterioration in yield. Univ. Col. No. Wales, Bangor, Agric., Rpt. Exts., **1920–21**: 48–50, 1921.

Transmission of leaf-roll of potatoes in N. Wales during 1921. Rpt. Int. Conf. Phytopath. and Econ. Ent. Holland, P. 147–149, H. Veenman & Sons. Wageningen, 1923.

The results of studies showing that this disease can be transmitted through the roots.

Plant virus diseases. Brit. Assoc. Adv. Sci. Rpt. (Abstract) **91**: 493, 1923.

Potato leaf-roll and degeneration in yield. Ann. Appl. Biology **11**(1): 31–41, 1924.

A progress report on methods of transmission and treatments.

Some experiments on potato leaf-roll transmission in Wales. Welsh Journ. Agric. **1**(1–10): 184–188, 1925.

Experiments on the control of potato leaf-roll. Welsh Journ. Agric. **3**: 169 180, 1927.

Phloem-necrosis and starch accumulation in potato leaf-roll. Rep. Brit. Assoc. p. 388–389, 1927.

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Potato leaf-roll. Development of secondary symptoms in the year of infection. Scottish Journ. Agric. **12**(2): 214–215, 1929.

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"Except for a short period covering the end of dormancy of the tuber to the first unfolding of the leaves, the infected plant respires at a much higher rate than does the healthy one. This is true also when the conditions of light temperature, and external carbon dioxide approximate to those present in the field."

"The rate of respiration is not directly related to the presence of virus but rather to the available amount of respirable substrate. Normally the accumulation of such substances in the leaves of leaf-roll plants occurs at a very early stage of development, but can be delayed

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A brief statement of the oxidizing enzyme theory.

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Cellular changes in ring-spot. Contrib. Boyce Thomp. Inst. **6** (1) : 51–67, 1934.

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A witches' broom of ocean spray (*Holodiscus discolor* Max.) Phytopathology **20**(10) : 851, 1930.

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Brief notes on the unusual types "fern leaf" and "witches broom" of raspberry diseases are given.

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PARING AND HEAT STERILIZATION OF THE CORMS TO ELIMINATE THE BANANA ROOT WEEVIL *COSMOPOLITES SORDIDUS* GERMAR

By FRANCISCO SEÍN, JR., *Assistant Entomologist*,
Insular Experiment Station, Río Piedras, Puerto Rico

METHODS ADVOCATED

Various methods for rendering the corms of bananas and plantains free from the "root" or corm weevil, *Cosmopolites sordidus* Germar, before planting have been advocated.

Total immersion in water or in water with arsenicals, and fumigation with carbon bisulphide may kill the insect if prolonged, but will also kill the plant tissues.

Simmonds (1) has reported satisfactory results when the suckers are immersed in water for 21 days up to four inches above the union of the stem with the corm, allowing the rest of the stem to protrude above the surface. If immersed totally for that length of time, the suckers die. We have made one test only of this method and in that, some larvae survived by having worked their way up to the parts above water. The length of time and the special conditions required render this method cumbersome. The tendency of the larvae to work upwards may result in the destruction of the bud in some of the suckers.

The immersion in boiling water for one minute may be sufficient to kill the eggs or the very small larvae located near the surface of the corm. To reach the large larvae located deeply inside the corms, the immersion would have to be very long. A long immersion would be cumbersome and may result in the destruction of many of the corms.

The only method which has proved practical because it can be carried out quickly and inexpensively, is the paring or cutting off of the external parts of the suckers. The older corms are more irregular in shape than the suckers and are therefore more difficult to pare.

Froggat (2) in 1926, recommended cutting a thin slice off the

whole sucker as far up as possible without damaging the eye or otherwise imparing its growing qualities.

We have found that cutting off a thin slice may remove the eggs but is likely to leave behind the small larvae which have started to tunnel into the corm. Such small larvae or their tunnels are difficult to detect.

In the future, heat sterilization may prove to be a practical way to free the corms of the weevil. We have done enough experimental work sterilizing infested corms at 43°C for eight hours in a circulating atmosphere saturated with moisture to show that it will free the corms from the weevil without injury. A field experiment is being conducted at the Station grounds to compare the results of paring with sterilization to determine which is more desirable.

THE NEED OF AN EFFECTIVE METHOD

Most of the banana varieties grown in Puerto Rico continue to produce satisfactory crops in most localities in spite of the weevil. Plantains, however, are so greatly injured in all localities that a second crop is usually unobtainable and even the first one is frequently a complete failure.

Plantains are greatly relished for cooking purposes and sell for about two cents each. Due to the difficulty of growing them because of the weevil, importations have to be made from Santo Domingo where the pest has not yet become prevalent. During the calendar year 1933, plantains valued at $84,690 were brought in from that island.

Bananas on fertile soil continue to produce for many years, plantains must be set into fresh soil after the second crop. Paring the suckers will serve equally well for bananas as for plantains, but the cultural practices followed render it more feasible with plantains.

PROCEDURE

The first step is to secure the best corms that can be obtained. (Fig. 1.) These should come from the least infested plantations and from stools showing few or no tunnels in the mother corms. Digging out the suckers as soon as they are large enough will also tend to reduce infestation. *All* suckers or corms are to be considered infested and conscientiously pared.

The weevils (Plate I) come out to feed and lay eggs at night. Once dug out of the soil, the suckers must be pared and removed from

PLATE I

Adult of *Cosmopolites sordidus* Germar. Twelve times natural size. (Original.)

the plantation before nightfall, because their cut surfaces are extremely attractive to the weevils, which will congregate and lay large numbers of eggs in them.

Paring will remove the eggs and the small larvae before they tunnel deeply. If the suckers are pared immediately after they are dug out, there will be less danger of the eggs hatching or of the larvae tunneling deeply.

After being pared, the suckers must be examined by the person interested in the success of the plantation. At that moment, all the outer dark tissues having been removed, any large tunnels present will become visible. Corms showing tunnels should be discarded. Ordinary laborers cannot be relied upon entirely, because they will not pare the suckers thoroughly and will pass some with tunnels as sound.

To pare, the suckers should be held by the stem. A layer one inch thick, or more, if the size of the sucker will permit, should be cut off from all over it. The outer leaf-sheaths should then be removed and the region at the union of the leaf-sheaths and the corm carefully pared (Fig. 2). Suckers reduced to three inches in diameter by paring have germinated well and produced strong plants. There should be no fear of easily injuring the corms and no need of cutting off only a thin slice. The paring should be as severe as possible.

After paring, the suckers may be planted immediately. Storing in a cool dry place for a week before planting is preferred by some growers. In that case the suckers may be stored after having been pared. To store them before paring would give the eggs the opportunity to hatch and permit the larvae to tunnel beyond reach.

The pared corms must be kept away from plantain or banana plants. Paring renders them exceedingly attractive to the weevils and they will become heavily re-infested if left within reach of the adults. Some growers have great faith in the immersion in boiling water. If it is to be practised, it should be carried out immediately after paring.

The parings should be scattered to dry out rapidly so that the eggs or small larvae in them will be killed.

OTHER PRECAUTIONS

It is useless to pare the suckers if they are to be planted in infested soil. For the soil to be free from the weevil it must have had no plantains or bananas for at least one year. It must be kept

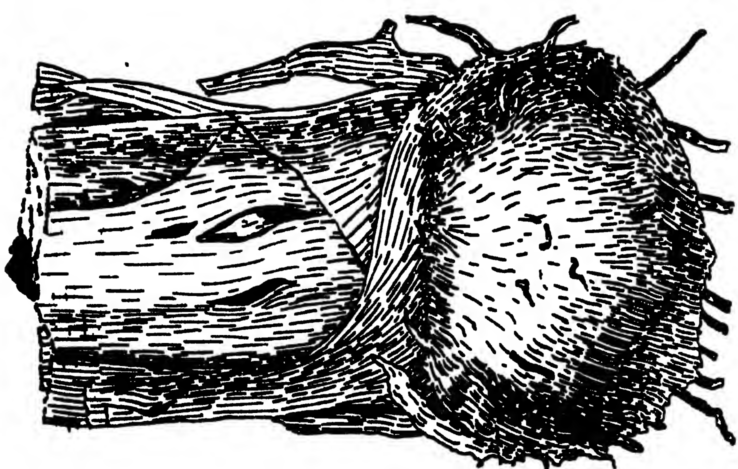

Fig. 1.—An apparently sound plantain corm. Such corms should be selected for treatment by paring, to obtain plants free from infestation by *Cosmopolites sordidus*. (Original.)

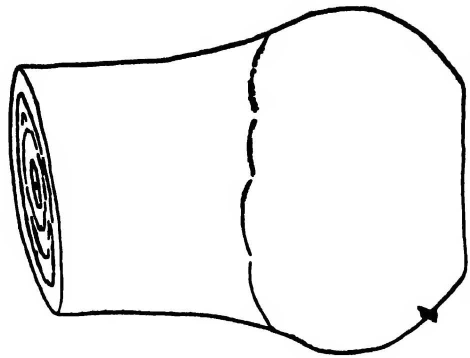

Fig. 2.—The same corm after having been pared. Note the comparative size. It is now ready to be planted. (Original.)

in mind that in plantations that are abandoned and allowed to die out by themselves, the corms persist for a long time and harbor the weevil.

The site for the new plantation must be removed from other plantations to prevent the beetles from crawling over or being washed down with trash by the heavy rains.

Paring may produce absolutely sound plants, but ordinarily a low percentage of infested plants is to be expected. Watch must be kept, therefore, over the plantation and any stunted plants with yellowish leaves that fail to unfurl normally should be inspected by cutting slices off the corm. If tunnels are detected, the plant must be dug out and the corm cut up to find and destroy any larvae, pupae or adults it may contain. From the more sound parts of the corm, slices are to be cut for traps. The slices are placed on the smoothed over soil where the plant was dug out. These traps attract the weevils that have migrated into the soil when they come out at night to feed. The weevils remain attached to the underside of the traps or hidden in the soil directly underneath them where they can be collected by hand and killed by dropping into cans with a little kerosene. After the surface of the traps dries out, a fresh surface can be exposed by cutting off a thin slice. After two weeks the traps should be finely chopped to destroy any larvae in them. Fresh traps should be kept on the ground until no more weevils come to them.

SUMMARY

1. Other methods of control except the paring of the corms or suckers as carried out by the writer, have been investigated and found either unreliable or unpractical. Sterilization at 43°C for eight hours in an adequate sterilizer, kills the insect without injury to the plant tissues. This method may prove to be practical.

2. Paring the suckers heavily, that is, cutting away one inch or more of all the external surface and removing also the external leaf-sheaths of its stem, will eliminate all or practically all of the eggs and the newly hatched larvae which have not yet tunneled deeply. Upon paring, the presence of larger larvae is shown by their tunnels. It is better to pare off as much as the size of the corm will allow for greater safety. Corms even when very severely pared germinate well.

3. The method can be used equally well with bananas or with plantains, but the cultural practices followed make it more desirable for plantains.

4. Suckers showing no tunnels—presumably uninfested—should

be selected, and even so, must be pared thoroughly. Corms showing tunnels are to be discarded.

5. Suckers for planting should be dug out as soon as they attain sufficient size. They should be taken from stools showing few or no tunnels in the mother corms and from the less infested plantations. If left on the ground overnight near plantain and banana plants, they may quickly become re-infested, especially after having been pared.

6. The paring must be supervised to make sure none of the old surface tissues are left on, or corms with tunnels passed as sound.

7. The pared corms are to be set in land free from the weevil and any plants that show infestation should be rogued and traps set to catch the weevils.

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THE DIAPAUSE PORTION OF THE LARVAL PERIOD OF *DIAPREPES ABBREVIATUS* L.

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Investigations on the life-history of *Diaprepes abbreviatus* L., initiated more than three years ago, are at present sufficiently complete to justify another report of progress. In a previous paper (1), the first part of the larval period, that of growth, has been discussed. Results of the rearings of the past year, conducted with grubs hatching from egg-clusters collected in alternate months throughout the year, indicate that little is to be added to the data there given on this part of the larval period. The variation in rapidity of growth is apparently not, to any considerate extent, due to time of year, but to the individuality of grubs, and the variation in vigor of grubs from different egg-clusters.

To eliminate possible disturbing factors in the more recent experiments, all egg-clusters were collected from a single small citrus nursery on the Station grounds at Río Piedras. At the beginning of the experiments, a single large can of soil was collected, and from this all soil used in the rearing work was taken as needed. Only rain water was used for moistening the soil. The grubs were supplied only with corn for food. All of the cans containing the growing grubs were kept in the same desk drawer, and, so far as possible, received the same treatment. The soil in the cans was maintained at a uniform humidity, so that ordinarily a single medicine-dropper-full of water at two-day intervals restored it to optimum humidity. The cans were examined three times a week; partly eaten corn and too large seedlings removed, growth of the grubs observed and recorded, fresh food and water added, and each can promptly returned to its place in the drawer beside the others. No record was kept of temperatures, but they were substantially the same as those recorded for the Station in the official Weather Bureau kiosk a few hundred feet distant.

One grub, from an egg-cluster hatching September 7, 1933, molted to eighth instar (which is considered the equivalent of having attained full growth) in 48 days, and two other individuals from this same exceptionally vigorous egg-cluster molted to eighth instar in 53 and 58 days, respectively. The best record for rapid growth

previously obtained was 59 days. Actually, this means little, for other individuals from the same cluster, receiving exactly the same treatment and having exactly the same opportunity to obtain food, required 100 and 119 days to attain the same size. The average period required by the 26 grubs reared from this cluster was 72 days; that of another cluster hatching in September 78 days. That of grubs from three clusters hatching in July was 86 days; that of grubs from three clusters hatching in November 85 days; of one cluster hatching in January 98 days, of another cluster hatching in January, the minimum was 100 days; of one cluster hatching in March, the minimum was 110 days. (Records for other months not yet available.) These records would appear to indicate that season of the year may have some effect, but temperatures certainly have little to do with rapidity of growth.

Admittedly, these records are obtained when the grubs are kept under what are supposed to be optimum conditions of food, cleanliness and moisture, and possibly they give little indication of what might be normal conditions in the field, especially in the more arid regions. The soundness of this criticism rests on the assumption that *Diaprepes* grubs ordinarily occur abundantly in arid or semi-arid regions; actually they are numerous mostly in irrigated fields where the soil is artificially maintained at a more or less even humidity by irrigation. In any case, the records establish a basis from which to estimate the effect of less favorable environments. That the conditions were optimum for growth is indicated by the fact that mortality among the growing grubs was practically nil, after each, in the 3rd or 4th instar, had been placed in a separate can. In the earlier instars, all the grubs from one egg-cluster were kept in one can, and the mortality due to crowding was high. Presumably, such mortality does not occur in the field, where the grubs disperse widely, and do not come in contact with each other after entering the soil. Even in the cans, crowding may not have been the only factor involved, for many more grubs survived to be transferred to separate cans out of what are designated as the more vigorous egg-clusters. No indication of vigor was to be noted in the egg-cluster itself, but the grubs from such clusters molted to second instar in a half or even a third of the time required by the grubs from other clusters. This appearance of superior vigor may be a delusion, and may have been induced entirely by a more favorable environment. Yet every effort was made to provide equally favorable environment for each egg-cluster: sprouted corn seedlings with some tender roots, in soil not quite so moist as that maintained

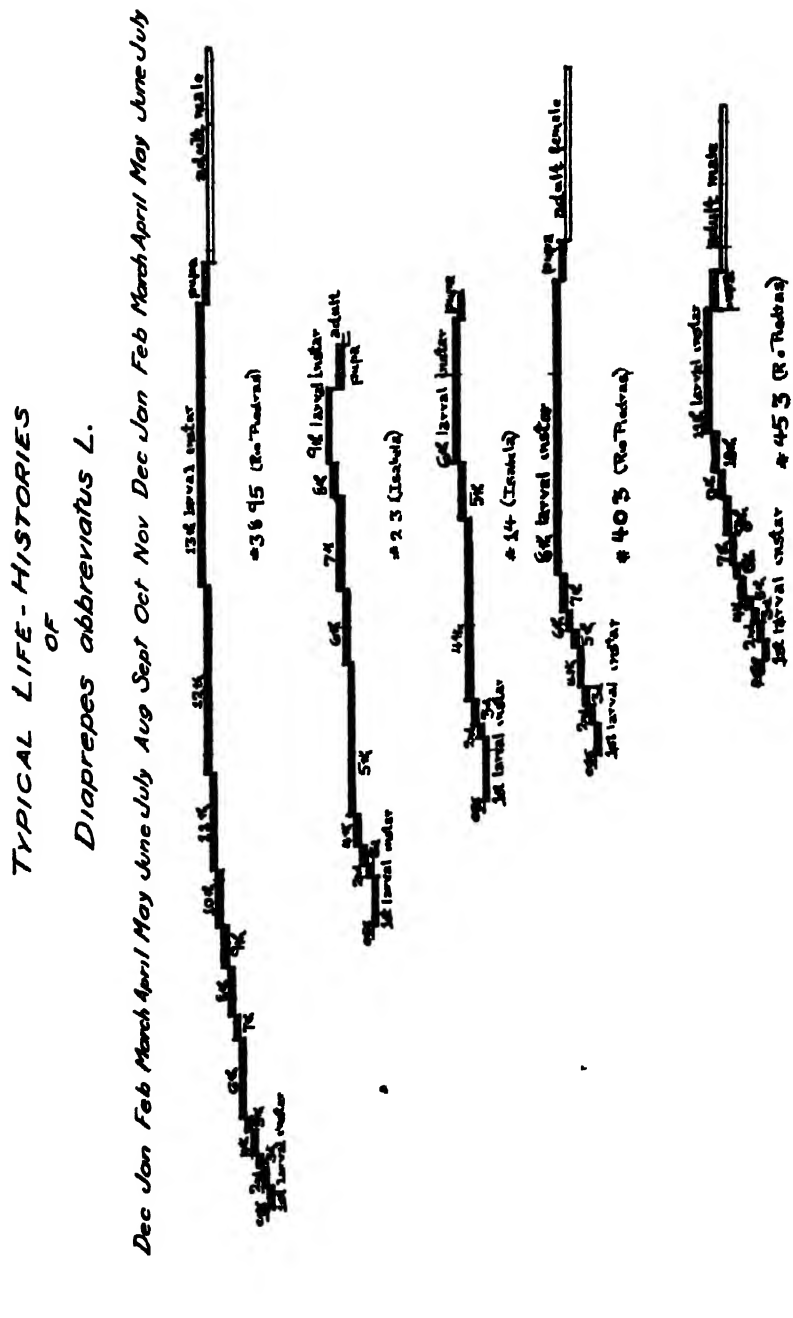
TYPICAL LIFE-HISTORIES
OF
Diaprepes abbreviatus L.
Dec Jan Feb March April May June July Aug Sept Oct Nov Dec Jan Feb March April May June July
adult male
adult female
adult male
#3695 (Rio Piedras)
#23 (Isabela)
#14 (Isabela)
#403 (Rio Piedras)
#453 (R. Piedras)

FIGURE 3

for the older grubs. It seems hardly likely that such slight differences in environment as would not be obvious to the experienced technician would so profoundly modify the vigor of the grubs as to be apparent not only in the number surviving and the rapidity of growth in the earlier instars, but still obvious thruout the growing period.

The success in rearing the grubs in the earlier growth instars was not, until recently, equaled in that of the later period of waiting previous to pupation. Out of all the grubs reared in 1932–33, only one survived to pupate. No assignable cause for death was apparent, yet each successive examination disclosed one or more deaths. Some of the grubs gave the appearance of being partially roasted, and to reduce the temperatures to what might be normal in the field, all the cans were placed in a cellar under the library building. The maximum and minimum thermometer kept beside them indicated little difference in temperatures from those obtained in the standard Weather Bureau kiosk outside, and fatalities continued, so that by fall only one grub was alive. Obviously, some other type of container must be provided to enable the grubs to live thru this waiting period before pupation.

One possible method of reducing temperatures, comparable to what occurs in the field, would be to have the container open at the top, inducing evaporation of moisture from the exposed soil. If an abundance of moisture were supplied from below at short intervals, the difference in temperature might mean the difference between the death of the grub and its successful pupation. To obtain such a container, thick glass tubes, an inch in diameter by four inches long, open at both top and bottom, were used. The bottom was closed by means of a plaster of Paris plug, ¾ to 1½ inch in height, poured into the tube, and such tubes, with a porous bottom, were placed on moist sand. Two-thirds full of soil, they promised to offer a superior environment for the grubs. To better understand the later modifications that were found necessary in the equipment of these tubes, a fuller discussion of the activities of the grubs during this waiting period should be given.

Molting to eighth instar has arbitrarily been taken as marking the transition from the period of growth to that of waiting before pupation, as most grubs attain their maximum weight at this time. At best, however, it indicated only the average of all grubs, not the condition of any individual grub. One precocious grub (No. 14 Isabela), as recorded in the previous paper, pupated from the sixth instar, and did most of its waiting when only half grown, in the

fourth instar. (See life-history chart, Fig. 3). This was during the months of September thru November, so this period can hardly be either aestivation or hibernation. Possibly it might be called a "diapause," a general term for such periods of waiting until the proper stimulus is received for a continuation of growth or transformation to the next stage of development. In the case of the grubs of *Diaprepes*, Dr. W. Dwight Pierce advises that it might more specifically be called "delayed pupation, active diapause." Ordinarily, it occurs when the grub has attained full size. During the first part of the period, the grub is exceptionally active or restless. In the closed containers, the earth is so thoroughly churned up that the corn seeedlings come to the top with most of their roots broken off. Later, especially if the soil is exceptionally moist, the grub may form an oval chamber in which it rests quietly, or this may be extended for several inches, and possibly in nature might be quite extensive. The grub rests in the chamber, but is roused to immediate activity when disturbed, and there is nothing suggestive of dormancy in the fact that it has made a definite chamber in the soil.

The beginning of this active diapause is evidenced by the fact that the grub ceases to eat. It may nibble a bit at the corn seedlings, but usually such injuries as they sustain are caused by the restlessness of the grub, rather than by its feeding. Its tentative nibbling is in no way comparable to its voracity of a few weeks previous, when it was making most rapid gains, and often almost entirely devouring one or two, or even three, grains of corn within two days. Ordinarily, the grubs which have grown most rapidly molt to ninth or tenth, or even eleventh instar before ceasing to eat, while those which have been most leisurely in attaining full size often show signs of having attained full growth by the time they have molted to seventh instar. In general, the grubs of an egg-cluster reach full size at about the same time, or at least this is a sufficiently close approximation to the fact so that all can be treated alike at the same time. When all the grubs gave plain indications that they were no longer eating, they were transferred to the open tubes. This was in from 100 to 125 days after hatching.

The first grubs transferred were still in the stage of aimless restlessness, when they were never quiet for long. Some of these grubs apparently came to the surface of the soil, something that would rarely occur in nature, but was induced by their cramped quarters in the tube, and as they were not found later, were presumably devoured by the lizards which infested the insectary. Others not only burrowed thru the soil, but also into the plaster of Paris stopper,

thru it, and escaped into the moist sand beneath. These could be recovered, and replaced in their tube, or a fresh one, but often repeated their escape from its confined area. To confine them within the tube, fresh tubes were prepared with a round section of wire screening sunk into the stopper by pouring an additional small amount of plaster of Paris on top of the screen. Such looked well

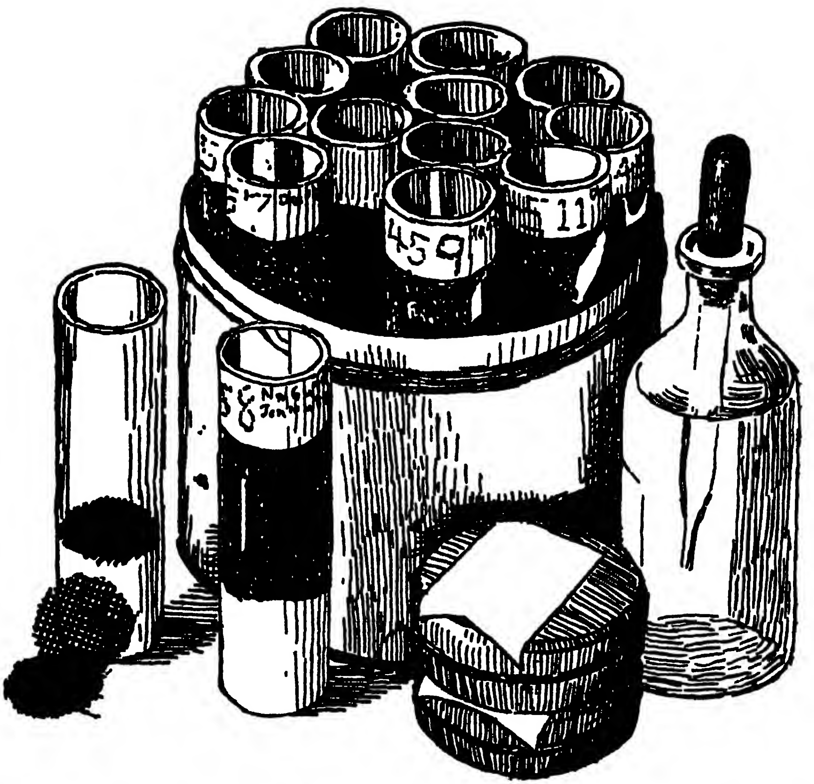

Fig. 4. Equipment used in rearing larvae of *Diaprepes abbreviatus* L. (Original)

before being used, but the restless grubs churned up so much of the plaster of Paris above the screen that later practise consisted of placing earth directly on the screen. (In the accompanying drawing, the completed tube, before adding the grub or earth is at the left; in front of which is a small pile of the circular screens, with one erect on top. Next is a tube in use, with earth, grub and label; behind is a series of tubes containing grubs from one egg-cluster, placed together on moist sand. In front are the tin salve boxes used for rearing during the growth period, and to the right the bottle of rain

water with medicine-dropper used for maintaining constant humidity in the cans.) One later refinement was to place another bit of screen on top of the earth, somewhat retarding evaporation to be sure, but at least insuring the safety of the grubs from the omnipresent powling lizards.

Previously unused portions of earth were placed with the grub in the tube, and as this earth had been air-dry for six or eight months previously, trouble was avoided from mites, worms and other soil inhabitants that had often become numerous in the closed containers and may possibly have been contributing factors in causing the death of the grubs. The grubs were not supplied with food in the open containers. It was anticipated that the small bore of the tube would give the grubs so little room that they could be kept under constant observation. Actually, the grubs were remarkably successful in keeping hidden most of the time, and for thoro inspection, most of the earth had to be dug out of the tube until the grub was exposed. Naturally, this could not be done often, and in practise, the tubes were casually examined only once or twice a week to add additional water to the sand beneath them. Rain water was added until the sand was saturated, and sometimes if the tubes seemed dry just above the plug, water was also added from above. Actually, the soil at the bottom of the tubes was found to be always very moist, when removed, even tho the top might be a hard, dry crust.

The first indication of the success of the use of this open-top type of container in permitting the grubs to pass this period of waiting previous to pupation was given on March 1, 1934. On this date, a clear area at the side of a tube containing a grub which had hatched from the egg on September 11, 1933, was noted, which, on being more closely examined was found to be a window thru which a freshly formed pupa could be plainly seen. The window was higher than it was wide, indicating that the pupal chamber was vertical, rather than horizontal, as had been all the chambers previously made by grubs in earlier stages of their existence. The pupa was entirely milky, waxy white, and very active when the tube was picked up. Such activity is presumably normal, for in this case it had caused the window by scraping away the mud separating the chamber from the glass, and apparently serves to further enlarge the chamber after pupation and to compact its sides. The pupa rested on its anus, vigorously wiggling from side to side, and gradually revolving on this as an axis. Within a few days its eyes had darkened, somewhat obscuring the individual facets which were at first very distinct,

its claws were black and the underwings also being somewhat darker than the remainder of the pupa. When observed on March 19th, it had transformed to a soft adult.

Within a few days, similar windows were observed in other tubes, and later, all tubes were opened, to find that in most cases the grubs had formed vertical pupal chambers in their base, but equidistant from the sides so that no external indication of the chamber was visible.

Of the twenty grubs which had hatched from eggs laid in July, one had died sometime early in April, after having molted to the ninth instar after 109 days, and to the tenth instar after 248 days, on March 26th. Another died in May, from undetermined cause. Six had disappeared, presumably having been eaten by lizards, hardly a normal end for soil-inhabiting grubs, and presumably practically never occurring in nature. All the others, 12 in number, pupated some time during March, and had transformed to adult after the middle of the month or early in April.

Of the 36 larvae which had hatched from eggs laid in September, 12 pupated in March or early in April, and transformed to adult shortly afterwards. (In all observed cases, the pupal period was not more than a day or two longer or shorter than 15 days, and this may be considered normal, as is 7 days for the eggs to hatch after deposition: surprisingly definite and fixed by comparison with the elasticity of the larval period.) Of these, two had reached eighth instar in 48 and 53 days respectively, and two had required 100 and 119 days to attain full size. That is: the two grubs which grew most rapidly and the two (out of the same egg-cluster) which grew most slowly, all pupated, and shortly afterwards became adult, at practically the same time. Of the others from these clusters, 8 died or disappeared during the spring, 2 pupated in May, 5 in June, 3 in July, 2 in August, while 4 are still active larvae at the end of August.

The grub with the shortest larval period was the one first noted, which, hatching on September 11th, molted to the eleventh instar after 115 days, and was first noted as pupa after 170 days, on March 1st. It had transformed to an adult by March 19th, after 188 days. To be sure, this adult was not hard enough to emerge from the ground, but it indicates a possible rapidity of development from egg to adult of only a little more than half a year. If the progeny from this individual could develop even a little more rapidly, this would seem to indicate the possibility of two generations in a year. Actually, all data point to no such possibility, for it did not come to the surface

of the soil until April 28th, and proved to be a male. Females do not begin oviposition until several days after emerging from the ground, seven days are required for hatching, and all grubs hatching from eggs laid in the spring grow slowly and have a longer diapause period than those hatching in the summer or early fall.

As an indication of what may be expected of grubs hatching later in the year, the case of the single grub which survived from the previous year's rearing may be cited. Hatching December 24, 1932, it grew more slowly than others from this exceptionally vigorous egg-cluster from Florida, Puerto Rico, molting to the eighth instar after 91 days, and after increasingly greater intervals to the thirteenth instar after 303 days, and was one of the first grubs to be placed in an open tube, in November 1933. Its development can not be detailed thereafter, for it not only avoided the side of the tube, but when the earth was later removed, it was found that the grub had burrowed into the center of the plaster of Paris stopper so that it was completely hidden from sight. Apparently, however, it had found a suitable environment, for when the stopper was broken up on March 23, 1934, a fully formed and quite hard male adult was found. Returned to the pupal chamber, it remained alive there quietly resting until April 28th. As an aerial adult it lived until July 5th. This individual had required somewhat less than 452 days from egg to adult, which presumably is the normal complement to other individuals which completed their transformation in much less than a year. Its total life was 557 days, or slightly over 1½ year. None of the fully grown grubs which hatched from eggs laid in November, 1933, show any indication of pupation in the spring or summer of 1934, altho all have attained their complete larval growth. Interpolating with the data of the three other grubs that have been reared to pupa (reported in the previous paper), it appears that the normal life-cycle of *Diaprepes abbreviatus* is completed in a year. Adults are most abundant in the late spring and early summer, and from the eggs laid by the females at this time, grubs develop during the fall which have their resting period during the winter, pupate in March of the following spring, and emerge as adults ready to complete the cycle just a year later. This is the normal cycle.

Practically all of the grubs hatching during July and August are able to complete their development by next spring, most of those hatching in September are able to do so. Possibly a few or those hatching in October are able to complete their life-cycle within half a year, but these are the exceptions, and all those hatching during later months have the extremely long life-cycle that is completed in

the second spring following. Some grubs may pupate at times other than in the spring, but the evidence to date consists of:

1 pupa in late January (shortly before Jan. 27th).
1 pupa in February.
22 pupae in March.
2 pupae in April.
2 pupae in May.
5 pupae in June.
3 pupae in July.
2 pupae in August.
1 pupa in September.

Transformation to adult, in the case of insects with subterranean immature stages, does not necessarily mean immediate emergence of the adult and its prompt functioning to start a new life-cycle. A great diversity of habits is to be expected of *Diaprepes*, and presumably some of the adults do not emerge from the ground when most of the others do, but appearing first much later, survive to lay eggs in the fall and winter Of fourteen adults on which observations are available, one emerged from the ground only twenty days after transformation from the pupal stage; most of them remained in the ground for a month or a month and a half; one for over three months. Adults are most abundant in the late spring, and cause the maximum of damage then by feeding on the tender leaves of citrus and avocado seedlings Even in captivity, some adults after emergence from the soil live for two and three months, and doubtless some of them live even longer in nature. These possibilities of variation in adult behavior may explain the presence of egg-clusters in every month of the year, but regardless of how one may account for their presence, the writer has experienced no difficulty in obtaining an abundance of eggs during every month of the year, at Río Piedras. They are ever so much more abundant, however, during the late spring, and this should fit in with the normal life-cycle of a year.

Apparently the most important factor in causing the variation found in the habits of *Diaprepes* is the presence of the egg-parasite, *Tetrastichus haitiensis* Gahan. This parasite is so abundant in the late spring and early summer that 95 per cent of parasitism of *Diaprepes* egg-cluters has repeatedly been observed at this time, when the host eggs are most numerous. As the season advances, the percentage of parasitism drops rapidly, and during the winter and spring is so low that only rarely are parasitized clusters found. Thus the parasite is of great value in reducing the numbers of grubs at the

time when they would normally be most abundant, but has little effect on them at other seasons of the year when they are relatively scarce. This naturally results in the survival of the progeny of exceptional adults, late to emerge from the ground or exceptionally long-lived and slow in oviposition, which escape parasitizm in the egg-stage. It would appear that the presence of the parasite is largely resonsible for disturbing the normal life-cycle of *Diaprepes*, for many of the adults appearing each spring are from egg-clusters laid out-of-season, which have thus escaped destruction by *Tetrastichus*.

This would also explain the more pronounced seasonal abundance of *Diaprepes* where all the land is planted to cane, for under these conditions, the eggs are laid between cane leaves, the tough tissues of which effectually prevent their being parasitized by *Tetrastichus*. This has two practical applications. (1) The period of hand-collection in cane regions may well be concentrated in the months of abundance. (2) To protect young citrus nurseries from grub attack, however, collections must be continued thruout the year, for the few beetles present in the fall, winter and early spring will lay as many eggs which will develop into grubs as do the great number of beetles appearing in the late spring. The flush of beetles in the spring causes the greatest damage to the leaves of the seedlings, but to protect their roots from damage by grubs, hand-collection of adults at ALL seasons of the year is indicated as being essential.

SUMMARY

By using an open-top, porous bottomed type of individual container for grubs of *Diaprepes abbreviatus* L. during their resting or "active diapause" period previous to pupation, numerous individuals have been successfully reared to adult.

In most cases observed, pupation occurs in the spring, regardless of when the grub hatched.

Few of the many egg-clusters laid in the late spring produce grubs, because of heavy parasitization by *Tetrastichus haitiensis* Gahan, but during the remainder of the year this parasite is scarce.

Diaprepes egg-clusters have been found in every month of the year; the grubs from some of these pupating in the next spring and completing their development in little more than six months, others have an exceptionally long "active diapause" terminated by pupation in the second spring, resulting in a life-cycle of several months more than one year.

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LIMA BEAN POD-BORER CATERPILLARS OF PUERTO RICO ON THEIR WILD HOSTS

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No observations on the various lima bean pod-borer caterpillars of Puerto Rico could be made during 1933–34, as no lima beans were commercially grown on the Island during that period. Experiments conducted during previous years in the attempted control of these caterpillars had been so inconclusive (1) that planting lima beans for the specific purpose of continuing them seemed hardly justified. Observations on these caterpillars were thus confined to what could be noted on their native hosts.

Quite by accident, a considerable number of plants of *Crotalaria incana* were discovered growing wild in an abandoned coconut grove on the beach between Mameyes and Luquillo, on June 25, 1933. Collections of mature pods, either green or brown, have since been made during every month in the year from these plants, or others supplanting them in the same locality, or from other plants growing elsewhere (Loíza Aldea and Isabela) under substantially similar environment. In most cases, the infestation of these pods by *Etiella zinckenella* Treit. was total, or very close to it, dropping below 90 per cent only during February, March and April, the minimum recorded (see table) being a very exceptional drop to only 60 per cent infestation for a small number of pods (40) on April 15, 1934. This appears to parallel, but not very closely, the previously recorded scarcity of this caterpillar in lima beans during the winter and early spring, and such seasonal variation is also indicated by the more careful observations made on all the pods collected from an artificial planting at Río Piedras.

INFESTATION BY CATERPILLARS OF *Etiella zinckenella* IN PODS OF *Crotalaria incana* GROWING:

On Sandy Beaches	*On Heavy Clay Soil*
June 25, 1933 at Mameyes: 100%	
	July 2 at Río Piedras (175 pods): 35%
	July 19 at Río Piedras (490 pods): 37%
	Aug. 6 at Río Piedras (368 pods): 44%
August 6, 1933 at Mameyes: 100%	
	Aug. 16 at Río Piedras (360 pods): 35%
Sept. 12, 1933 at Isabela: 85–90%	
Sept. 25 at Mameyes (160 pods): 90%	
Oct. 29 at Loíza (60 pods): 84%	
Nov. 12 at Mameyes (80 pods): 91%	
Dec. 3 at Mameyes: 91%	
Dec. 17 at Mameyes: 100%	
	Dec. 29 at Río Piedras (114 pods): 1.0%
	Jan. 13 at Río Piedras (202 pods): 2.5%
	Jan. 25 at Río Piedras (220 pods): 4.0%
Jan. 28 at Mameyes: 100%	
	Feb. 9 at Río Piedras (510 pods): 0.2%
	Feb. 20 at Río Piedras (600 pods): 13.3%
	Feb. 27 at Río Piedras (690 pods): 5%
	March 8 at Río Piedras (370 pods): 1%
March 11 at Mameyes: 87%	
	March 14 at Río Piedras (327 pods): 2%
	March 20 at Río Piedras (258 pods): 2%
	March 27 at Río Piedras (220 pods): 8.6%
March 29 at Mameyes: 93%	
	April 10 at Río Piedras (530 pods): 8%
April 15 at Mameyes (40 pods): 60.0%	
	April 20 at Río Piedras (370 pods): .00%
	April 30 at Río Piedras (220 pods): .00%
April 29 at Loíza:	
(100 brown pods): 92%	
(70 green pods): 80%	
	May 14 at Río Piedras (330 pods): 26.0%
	May 15 at Río Piedras (158 pods): 50.0%
June 25 at Mameyes (110 pods): 89%	June 20 at Río Piedras (680 pods): 15.0%

After the initial discovery of *Crotalaria incana* growing wild on the beach at Mameyes, search elsewhere showed that this species, although by no means as abundant as the common, bright, showy-flowered *Crotalaria retusa*, is nevertheless often to be found, not only on sandy beaches, but almost anywhere in abandoned areas not closely pastured, especially along roadsides and railroad tracks. A few plants from various points close to Río Piedras, but all growing on heavy clay soil, had all pods free from infestation by *Etiella*. To determine whether this was merely an accident, or a normal condi-

tion, a planting of a small bed on the Station grounds at Río Piedras was established, from which all pods were collected and examined. The results of these examinations, as shown in the accompanying table, indicates a comparable seasonal variation, together with a very definite freedom from infestation, apparently due to type of soil. Every effort was made to increase the infestation during the winter, as all infested pods from Mameyes were placed on the ground at the base of these plants, without any apparent effect at that time. These plants averaged about three feet in height before beginning to produce pods, and some attained a maximum height of four feet. A supplementary planting made at the end of January began to have flowers early in April, when the plants were only a foot high, and had matured pods by early in May, the maximum height being only 18 inches.

The pods of *Crotalaria retusa,* which never in Puerto Rico have been found infested with *Etiella zinckenella,* are smooth and shining; those of *C. incana* are distinctly hairy Whether this is the character which determines the selection of these pods for oviposition by the female moths, or some other, can only be determined in countries where the number of alternate hosts is greater than in Puerto Rico.

On *Crotalaria incana,* the eggs are laid between the hairs, usually in the keel-shaped depression on the upper side of the pods, more rarely on the sides or beneath "The egg is glistening white when first laid, but after a few days its upper surface becomes mottled with red spots" (2). Most of the eggs noted in Puerto Rico were slightly pinkish or flesh-colored, others showed the mottling noted by Dr. Flanders. In shape, the egg is oval, but rarely regular, most of those observed on *Crotalaria* being considerably flattened on the side towards the pod, and often somewhat pulled out of shape by the hairs between which they are laid. The reticulations on the egg-shell are often so irregular as to suggest no definite pattern, yet in other cases, especially when observed after the emergence of the caterpillar, they can be plainly seen to consist of a series of pyramids arranged like the conventionalized pineapple design. Out of the hundreds of eggs examined, only a single instance of parasitization by *Trichogramma minutum* Riley was noted.

Immediately before hatching, the egg is more or less dark orange towards the center. The just-hatched caterpillar is yellowish, with an enormous black head. It eats hairs and the outer skin of the pod first, making somewhat of a bower of silk and excrement and uneaten ends of the hairs, before burrowing inside. As many as eight eggs have been noted on a single *Crotalaria* pod, and often

three and four are to be found, yet rarely does more than a single caterpillar occur within. Within the pod, the caterpillar feeds on the immature seeds, making an extensive network of silken fibers and entangled excrement within the pod before it attains full size. Its later growth stages—a greenish caterpillar with black or very dark head, and in the last instar with a clear pro-thoracic shield marked with black—have previously been described (1).

The wild beach sword bean, *Canavalia maritima,* grows in abundance on the beach at Mameyes, and every time a collection of *Crotalaria incana* pods was made, incidental observations were made on the beach beans to determine a possible seasonal variation in their infestation by *Fundella cistipennis* Dyar. This caterpillar is also found attacking the pods of *Cassia occidentalis,* a common shrub springing up after cultivated crops have been harvested, or growing along roadsides. In both hosts, heavy infestations were found every time search was made for them. A careful examination of flower sprays of *Canavalia maritima* picked at Mameyes December 1, 1933, indicated that buds and flowers, as well as pods in all early stages of development, were eaten by the caterpillars. The eggs were noted in considerable abundance, in practically all cases being laid on the calyx. If the calyx of the unopened bud is fresh and plump, the egg is laid in the depression where the lower lobes fold against the upper one. On the withered calyx, the egg is laid anywhere. As many as seven eggs on a single calyx were counted. The eggs are a dark intense pink, oval in outline, tightly glued to the plant surface, and somewhat flattened in contact with it. The upper surface is finely reticulate, with an irregular pattern of somewhat elongate polygons. When about to hatch, the egg becomes grey, and soon the head of the caterpillar can be seen in motion with its jaws chewing a hole in the side. As soon as the hole is large enough, the caterpillar crawls out without delay and moves away from the empty shell. Its head is relatively enormous in size, dark brown in color, the slender body being light yellowish brown, with a central darker stripe thru the middle to mark the position of the empty alimentary canal.

On *Cassia occidentalis,* the eggs of *Fundella cistipennis* are sometimes laid on the underside of the very tender leaves, but when flower sprays are present, the majority of the eggs are found at the base of the young pods, on its torus or receptacle: the scar left by the falling off of the withered flower. When laid in this depression, the egg appears quite flat and scale-like, being almost level on the

upper, exposed surface, but even more convex where it fits into the crease of the torus.

The attempt at control of the lima bean pod-borers by means of spraying with pyrethrum was based on the assumption that this might kill the eggs or small caterpillars before they entered the pod. To test this possibility, branches of *Crotalaria incana* bearing many green pods on which the eggs of *Etiella zinckenella* had been laid were sprayed with pyragol, diluted 1 to 200 with rain water. Within the next few days, every egg hatched. The experiment was repeated, using a dilution of 1 to 100, with the same results. A third spraying (of fresh pods) with a dilution of 1 to 75 caused considerable temporary curling of the leaves, and also had no effect on the eggs. Nor was any effect to be observed on the young caterpillars.

To duplicate this experiment with the eggs of *Fundella cistipennis*, bunches of freshly picked flower clusters of *Canavalia maritima* were sprayed with pyragol, diluted 1 to 200, 1 to 100 and 1 to 75. In no case did this treatment prevent the hatching of the eggs, or kill any caterpillars. In all stages of growth, however, the caterpillars are readily susceptible to drowning, for all present overnight in pods below the water level were dead by the next morning.

These experiments indicate that the only possible value which pyrethrum might possess is in discouraging oviposition on sprayed plants. An experiment to determine this point, conducted on wild plants on the beach could not be kept under daily observation, and it was not until late in the summer of 1934 that the pods of *Crotalaria incana* at Río Piedras were sufficiently infested to be used for such an experiment. They had been planted in two rows, and one of these was sprayed with pyragol, diluted 1 to 100 with water, on August 16th, and again on August 20th, the other row being intended to serve as check. Unfortunately, the two rows were only a little over four feet apart, so that the fumes of the poison apparently also affected oviposition on the check. The first count made on the pods, August 27th, showed a drop from the July-August average of 38% to 11.1% on the sprayed row and 14.5% on the check row. The second examination of pods made on September 10th showed 16.5% infestation on 314 sprayed pods, as compared with 31.0% infestation on 83 check pods. These results are not entirely conclusive, but they appear to indicate that pyrethrum may have a definite value in preventing oviposition by the females of *Etiella zinckenella*. No comparable experiments with *Fundella cistipennis* were attempted.

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THE LARVAE OF *LYCAENA THEONUS* LUCAS FEED ON BUDS AND FLOWERS OF LIMA BEAN AND *CROTALARIA INCANA* IN PUERTO RICO

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The small, greenish, slug-like caterpillars of the little blue butterfly, *Lycaena theonus* Lucas, are reported by Bruner (1) as feeding on the pods of lima beans in Cuba These butterflies were extremely abundant at Isabela in 1931–32 in a planting of young casuarina trees close to a field of lima beans, but the larvae were not discovered at the time. In a close examination of a few lima bean plants at Río Piedras, August 2, 1933, two larvae were noted eating the flowers and buds. One transformed to a gray pupa, from which an adult emerged which was determined by Dr. Wm. Schaus, the present being the first published record of this species from Puerto Rico.

Later, when many pods of *Crotalaria incana* were being collected at Mameyes, several caterpillars were found among the immature pods, possibly feeding upon them, or more probably on the buds and flowers. At Río Piedras, butterflies were observed hovering over the *Crotalaria* plants, and at times alighting upon them. One female was observed to oviposit, Dec. 28, 1933, on the very top of a flower spray, the egg being light bluish-green in color, turban-shaped like the illustration (Fig. 7) in Holland's "The Butterfly Book," but not so deeply sculptured, and entirely smooth in the depression on top.

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THE PRESENT STATUS OF WHITE GRUB PARASITES IN PUERTO RICO

By George N. Wolcott, *Entomologist*,
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In less than ten years after its first introduction into Puerto Rico, the giant toad, *Bufo marinus* L., has changed the economic status of white grubs on the Island from that of a major pest to one of comparative rarity. The most obvious indication of such change is that fields of sugar cane on the South Coast, especially in the districts where grubs were formerly most abundant, can now be successfully and profitably ratooned. When white grubs were abundant, such a procedure would have been impossible; now it is the rule. Formerly the roots of sugar cane were often so completely destroyed that the stalks had to be harvested months in advance of normal maturity; now they are so numerous that plowing and replanting are obviously unnecessary. To be sure, different varieties of cane are now being grown, and some other factors have been changed, but the one of importance is that white grubs are no longer present in sufficient numbers to cause appreciable injury to the cane roots. For this changed condition, the imported toad is almost entirely responsible.

Before the toad was introduced into Puerto Rico, careful studies on the natural enemies of white grubs indicated that, altho locally some of these native parasites were at times quite abundant, their effect on the white grub population as a whole was so slight as to be inappreciable. No definite records of abundance of the parasites at this earlier period are now available, so that an exact comparison with present conditions is impossible. Quite recently, the opportunity to judge of the present status of some of those parasites was furnished by the investigations of Mr. Walter F. Jepson, sent here by the sugar planters of Mauritius to collect white grub parasites for importation into that Island.

Two species of Tachinid flies, *Cryptomeigenia aurifacies* Walton and *Eutrixoides jonesii* Walton, were first discovered attacking May beetles at Añasco in 1912 by Messrs. Doige, Van Dine and Jones, (1) and were later collected in considerable abundance at Río Piedras by E. G. Smyth. During the spring and summer of 1933, Mr. Jepson collected thousands of May beetles at Añasco, Río Piedras and Cidra,

from these recovering none of the latter species, and at Cidra only found approximately 1% of parasitism by the former

The most extended investigations on the Scoliid wasp parasites of white grubs were conducted by Mr. H. D. Box at Aguirre (2), at a time when the toad had already been introduced, but before it had become sufficiently abundant to have produced an appreciable effect on the white grub population. Because of the scarcity of the Tachinid flies, Mr. Jepson concentrated his efforts on the Scoliid wasps, and the following paragraphs are taken from an informal report (3) which he presented to the writer shortly before his return to Mauritius.

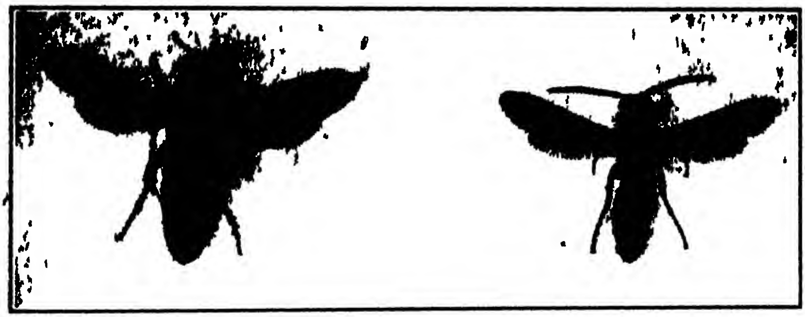

FIG. 5.—Female and male of *Campsomeris trifasciata* F. (after Box.)

"The species *Campsomeris trifasciata* F. was found by Box at only one spot near Aguirre This locality was revisited and females found, during the present work, over eight years later. At no other locality on the South Coast has this species been found, but several females were seen at Isabela. Males have been seen, on *Mitracarpus portoricensis*, in a field at Km. 33 4 along the San Juan–Arecibo road. In addition, a locality where twenty females may be obtained in a morning has been found in the hills, on Treasure Island Plantation, Cidra, in a field of abandoned pineapples, to the right of the Camp road 150 yards beyond the packing shed. The food plant is a pink straggling labiate; the males frequenting *Mitracarpus*."

"*Elis xanthonotus* Rohwer seems, with the foregoing species, to prefer the heavier soil types, and is, in addition, absent from the South Coast belt; its attachment to *Mitracarpus* as a food plant for both sexes may in this case be a determining factor. No specimens were collected at Santa Rita (Guánica), nor on the West Coast until Isabela was reached. Many individuals have been seen on the San Juan–Arecibo road, but the place of maximum abundance discovered is at Cidra, where the females are, on sunny mornings, the commonest Hymenoptera. Up to 150 individuals have been secured in a single morning's collecting. In an adjacent field, full of *Mitracarpus*, no trace of *Elis* could be found. The flight is spasmodic and tumbling, and the range evidently not great. The greatest success in rearing this species has been on the large grubs of *Phyllophaga*

portoricensis or *vandinei*, though in the absence of these, oviposition and development takes place readily on 2nd stage grubs, and the mature grubs of *P. citri*; the cocoons being naturally much smaller on the latter species. The time of development is longer at Cidra than that recorded by Box at Aguirre, the egg stage occupies over two days against 32 hours, and the larval period 8–10 days against 5 days in the South."

"*Campsomeris pyrura* Rohwer, which was not found by Box at Aguirre, appears not uncommonly at Cidra. The males are quite abundant, both sexes frequenting *Mitracarpus*. No eggs have yet been obtained, and the species can have but little importance as a controlling agent, if, indeed, it be a parasite of *Phyllophaga* spp."

It should be noted that these later observations by Jepson, mostly at Cidra, or along the North Coast, are hardly comparable to those of Box at Aguirre, and give little clue as to a changed status due to the introduction of the toad. Indeed, even concerning *Campsomeris dorsata* F., the parasite of the Dynastid beetle, *Dyscinetus tumulosus* Burmeister, Jepson, recording observations made in the summer of 1933, only echoes Box in stating that it "is but rarely met with away from the South Coast, where it is by far the commonest Scoliid". Of all the Scoliids he took with him, it was the only one of which releases were eventually made in Mauritius, the wasps apparently possessing exceptional longevity, some of the females traveling 53 days and living over 40 days after arrival.

FIG. 6.—Female and male of *Campsomeris dorsata* F. (after Box.)

That *Campsomeris dorsata* was not an exclusively South Coast species was already known, for collection had been made at Maunabo, Trujillo Alto and Arecibo (4), but finding it in abundance on the North Coast was hardly to be anticipated. On June 7, 1933, Mr. Jepson and the writer noted several hundred males of this species resting in five or six clusters on low casuarina trees at the side of the School of Tropical Medicine, Puerta de Tierra, San Juan. So far as known, this is not only the first record of abundance on the

North Coast, but also the first record of this swarming habit of the males, similar to that which has been so often observed of *Elis haemorrhoidalis* F. The School adjoins the U. S. Army barracks, and presumably the wasps had found there an abundance of host material, as *Ligyrus* grubs feed on decaying horse and mule manure as well as on cachaza and decaying cane stools and trash in the ground.

Apparently *Campsomeris dorsata* has experienced tremendous variations in abundance in Puerto Rico, for Gundlach in 1894 (5) records it as rare. The earliest economic record is in a letter written by Mr. H. Bourne, at that time in charge of field experimental work for Guánica Central, from Santa Rita on June 20, 1913.

> "While I was getting these grubs (of *Ligyrus tumulosus* Burm.) I found 28 cocoons of a wasp, very probably the black one with two reddish bands across the abdomen, because while digging, two flew out. This wasp is commonly seen in the *callejones* and cane fields. I also found one grub with a large size larva of a wasp attached to its body, one grub with a medium sized larva attached to it, and one with the egg of a wasp freshly laid on its body."

In May, 1934, in the fields where he made these observations, only ten or twelve females were to be noted in a morning, mostly frequenting the flowers of the common bur marigold, *Bidens pilosa* L. Nothing comparable to the thousands inferred by Bourne and recorded by Box a few years previously was to be seen, even tho all conditions were apparently propitious: an abundance of cachaza in the field (for *Ligyrus* grubs) and an abundance of flowers for the wasps. It is evident that here the toad had so changed the balance of nature that *Ligyrus* had practically disappeared, and without a host, the wasp had also almost disappeared in this its previously most abundant habitat. The observations of Mrs. Dexter (6) on the food of the toad in cane fields indicate, indeed, that the wasps themselves are eaten: that is, both host and parasite are consumed by *Bufo marinus*.

Casual observations on the apparent abundance of this wasp may be grossly inaccurate, if made at the wrong time of day. On a bright sunny morning, no female wasps are to be found before 8 o'clock, and rarely are any to be seen until 9:00 A. M. From then until 11:00 A. M., they occur in increasing abundance, the males beginning to appear about 10:30 A. M. The appearance of the males, however, indicates the beginning of the end of the presence of the females on flowers, for while the males frequent the flowers during the hottest part of the day, the females are practically never present after 11:00 A. M. except when the early morning has been cloudy. No females at all appear during cloudy weather, and none are to be seen

when a passing cloud temporarily obscures the sun. The common bur-marigold, *Bidens pilosa*, serves quite as well as a host for the females as do the flowers mentioned by Box, but the flower preferred by the females is the large yellow Calthrope, *Tribulus cistoides* L., present in considerable abundance in Puerto Rico only in San Juan and Puerta de Tierra. These flowers have a delightful perfume, suggestive of pansies, but they begin to close before noon, like the much smaller and paler yellow ones of the closely allied *Kallstroemia maxima*. Of this, Box states that "during its flowering season thousands of Hymenoptera are attracted by its delicate bloom; among the wasps, the Scoliid *Dielis dorsata* is the most frequent, and on sunny mornings thousands of the females of this species may be seen in most places where this plant occurs". A few wasps have been observed at Puerta de Tierra to feed only on this smaller yellow flower, but the great majority of them frequent only the larger and showier one. The early fading of these preferred hosts may have affected the feeding habits of the wasps to such an extent that they make no attempt to feed after these flowers are gone for the day.

During the summer of 1934, five times as many wasps were to be seen on the few patches of yellow Calthrope which encroaching building has left in existence on the wind-swept cliffs of Puerta de Tierra as at any point of the South Coast with a practically unlimited supply of flowers. Apparently the toad as a decisive factor has been practically eliminated in Puerta de Tierra by the impact of heavy urban street traffic, the few areas in which to hide during the day, and the scarcity of pools in which the immature stage might be passed. Thus, with an abundance of horse and mule manure available as host for the larva stage of *Ligyrus tumulosus*, the elimination of the chief predator (the toad) on these beetles has made possible the existence of their parasite, *Campsomeris dorsata*, in greater numbers than elsewhere in Puerto Rico.

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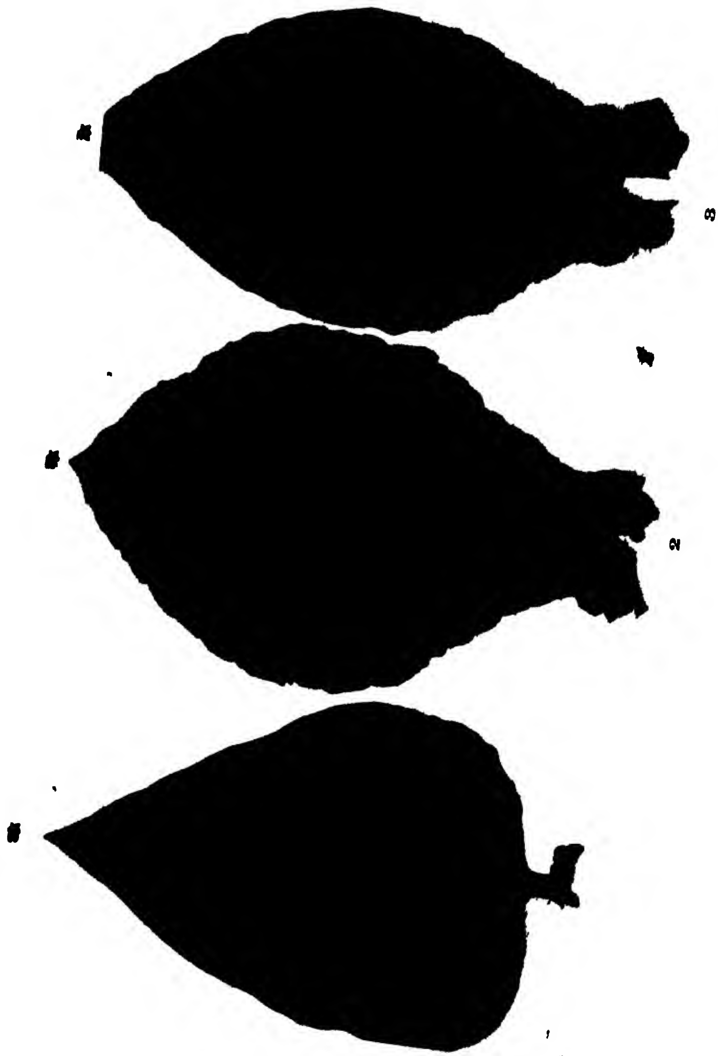
PLATE II.



EXPLANATION OF PLATE II

FIGURE 1.—Leaf of normal green Turkish tobacco.

FIGURE 2.—Leaf of No. 43, a yellowish-green "Ceniza" selection to show the yy character of Consolation tobacco.

FIGURE 3.—Leaf of "Ceniza" or *glaucous* tobacco.

(The true characters have been poorly represented in the plate, the yellowish-green character is more uniformly yellow and the greens show too much of the yellow shade.)

NOTICE

By Act of the Legislature of the Insular Government of Puerto Rico, the Insular Experiment Station has been transferred from the Department of Agriculture and Commerce of Puerto Rico to the University of Puerto Rico and the name of the Station changed to Agricultural Experiment Station of the College of Agriculture and Mechanic Arts of the University of Puerto Rico.

In accordance with this change;

The present JOURNAL OF AGRICULTURE OF THE UNIVERSITY OF PUERTO RICO, starts with Volume XVIII, January 1934, and is a continuation of the JOURNAL OF THE DEPARTMENT OF AGRICULTURE OF PUERTO RICO, which suspended publication with the completion of Volume XVII, 1933.

Very truly,

MELVILLE T. COOK,
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INHERITANCE IN NICOTIANA. I. STUDY OF THE GLAUCOUS AND THE YELLOW CHARACTERS IN *N. TABACUM* L.

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INTRODUCTION

Several years ago the writer became interested in some morphological characters in *Nicotiana tabacum* L. while making preliminary studies with relative resistance of a number of tobacco varieties to tropical diseases. This study is therefore an outgrowth of another investigation. Materials have been accumulated steadily in our collection and although our interest is primarily of a phytopathological nature it has been and will be our purpose to render a genetical interpretation of such morphological characters as come to our attention and which appear not to have been described or analyzed genetically up to this time. We believe that the phytopathologist will make more rapid progress in studies on immunity which may lead to the development of disease-resistant strains of our crop plants when he knows more about the general genetical behavior of his plant materials. This knowledge will eliminate to a considerable extent many of the retarding factors which enter into the picture of the control of plant diseases by the use of resistant varieties, and consequently will simplify the methods, facilitate the planning of the experiments, shorten the period of the investigations and assure more prompt results.

This short paper proposes to constitute the first of what may become a series of studies on the genetics of Nicotiana. These studies were begun at the Insular Agricultural Experiment Station of Puerto Rico in 1928 and continued in Cornell University in 1930–32 and in the University of Wisconsin in 1932–33.

MATERIALS AND METHODS

The *glaucous* character reported herein occurs on a Puerto Rican

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commercial tobacco which has been known locally under the name of "Ceniza", meaning *ash*. The name refers to the peculiar appearance of the leaves which suggests a bluish or grayish green color. This character can be detected in the seed-bed at an early age but may be difficult to separate when seedlings are very crowded. For this reason, young seedlings should be transplanted to a second plant bed where more space will insure favorable conditions for development thereby minimizing the chances of failure in detecting the *glaucous* plants. Plants of this latter strain grow slower than ordinary tobaccos, the leaves are thick and the veins branch out from the midrib at an acute angle. The *glaucous* character appears not to have been described from any other country.

The *yellow* character as used here applies to a plant color which might more properly be designated as yellowish-green. This color is peculiar to normal plants at all stages of growth and is easily recognized in very young seedlings. The strain used in our studies is a pure line of a wrapper tobacco planted by a local company prior to the year 1927 in the tobacco districts at the higher altitudes of the island and which was believed to have descended from a single yellow plant discovered by a laborer in the back yard of his house. It is undoubtedly a mutation from a Puerto Rican variety. It was given the name of "Consolation" because it was discovered at a time when light wrappers were much in fashion among smokers and the industry here would have suffered tremendously had it not been for this timely discovery. But the advantage which the new tobacco brought to the growers was to dwindle away years later when the Consolation wrapper fell into disrepute. This yellow tobacco should not be confused with the *White Burley* tobacco studied by Henika (1) from which it differs in morphological expression and in being due to a single factor whereas the latter represents a two-factor difference. It seems also to be distinct from a tobacco variety which showed a golden color of leaves just before maturity and which was studied by Kajanus (2), who found an approximation to a genetical ratio of 15:1 for color.

The two characters reported herein were studied in the same crosses, thereby expediting the handling of a larger number of individuals for each character. The normal yellow tobacco is *non-glaucous* while the "Ceniza" or *glaucous*, being green, serves as a contrast to *yellow*. Other crosses which could not be carried beyond the second generation were also made with other *non-glaucous* or *non-yellow* pure lines.

In making counts for the yellow character it was only necessary to sow seed rather thinly in flats, then pricking out the seedlings with forceps when ten to fifteen days old. This method made possible the study of large numbers of seedlings. Another method employed was to transplant large plants from a seed-bed prepared in the usual way and making observations and counts in the field. It was soon found this method was unnecessary. In order to ascertain whether plants classified in the seed-bed as yellow or green were correctly determined, plantings of small seedlings grouped under the two classes were made in the greenhouse in one-and-a half-inch pots. Final counts made at the age of twenty-eight days, showed that the classification had been made accurately.

The separation of the *glaucous* or ashy seedlings was extraordinarily difficult in the seed-bed. It was found, however, that they could be detected in about a month after transplanting into small pots in the greenhouse, or into flats or beds when set at a longitudinal and transversal distance of two and one-half inches. They were transplanted into these when about two weeks old and counts could be made ten to fifteen days later. In doubtful cases the seedlings were further transplanted and kept f r an additional period of two weeks when final counts were made on such individuals.

The same procedure was followed for all crosses and selfings.

In the determination of *ashy* or *glaucous* segregates the young seedlings were transplanted into flats of the usual size, transplanting thirty-five plants to each flat. The number of observations made in each progeny varied, depending upon the greenhouse and other facilities available at the time the different progenies were studied. In general, the population was fairly large.

In the season of 1928–1929 the following crosses were made: *glaucous* or "Ceniza" (Ce) × *yellow* or "*Consolation*" (Kon); green Turkish Sansum (T) × Kon; Ce × T; all direct and reciprocal. The first generations of these crosses were all grown at the Insular Experiment Station of Puertò Rico in the year 1928–29 and all selfings and backcrosses were then performed. The second and backcross generations were grown either at the Insular Experiment Station or in the greenhouse at Cornell University in the fall and winter of 1931; while further F_2 and third generations were grown in the spring and summer of 1932 at the latter institution. Third generation progenies were also studied at the Department of Horticulture, University of Wisconsin, in the summer of 1933.

The two characters, *yellow* and *glaucous*, are discussed separately. However, the data are from the same crosses.

In determining the significance of the genetical results given below, the probable error and Chi-square methods were employed. The probable error of numbers was determined in testing the significance of the 3:1 and 15:1 mendelian ratios. The expression Dev./P.E. was used as the measure of significance, taking Dev./P.E. = 3.2, as the lower level of significance, which represents odds of 31.36 to 1 against the occurrence of a deviation as great as or greater than the designated one. Values higher than 3.2 are regarded as giving odds higher than 31.36 that the deviations are not due to random sampling. In the application of the Chi-square method for goodness of fit, values of *P* were calculated by referring to Elderton's tables. It was considered that values of P equal to 0.05 or lower, indicated odds too high for such deviations to be due to random sampling.

RESULTS

The Yellow Character

The first generation of the crosses for the study of green and yellow was in all cases green, showing that the allelomorph *yellow* is a recessive character.

In the second generation of the direct and reciprocal crosses the seedlings were grouped into the two classes: green and yellow. From the data obtained in the F_2 of the cross *Ce* × *Kon* and *Kon* × *Ce* a hypothesis of a single factor relation between green and yellow was formulated. The figures are given in Table I, under *Kon* × *Ce* — A and *Ce* × *Kon* — A. In either case deviations can be attributed to random sampling.

Evidence from the Second generation.—In order to test the hypothesis, several F_2 progenies of the above cross were studied and in addition the cross *Kon* × *T* was made. Table I contains the distribution of the F_2 phenotypes in six progenies of the cross *Kon* × *Ce;* two progenies of the reciprocal cross and the direct and reciprocal cross *Kon* × *T*.

An examination of the figures shows a fairly close fit of the results to a 3:1 ratio of green to yellow seedlings. In only one progeny *Kon* × *Ce* — D is the deviation high enough to bring the results near the border line of significance. From the above F_2 results it seems evident that the single factor difference between green and yellow is appropriate in this case.

Evidence from the backcross.—Several of the F_1 plants which were selfed for F_2 studies were also backcrossed to the *yellow* parent. The F_1's of the cross *Kon* × *T* were backcrossed to no. 45, a *yellow* segregate from the cross *Ce* × *Kon* — A, which was also recessive for the "Ceniza" character. The latter are included although the crosses had been mainly intended for the study of the *Ce* character. These backcross progenies are given in Table II. Progeny ((*Kon* × *Ce*) × *Kon*)— B shows a deviation in the distribution of green and normal seedlings which appears too high to be attributed to random sampling, the D/P.E. being 3.62. The remaining eight backcross progenies show a fairly close agreement to the expected 1:1 ratio for single-factor differences. It is, therefore, safe to conclude that on the basis of backcross results a single-factor difference exists between green and *yellow*.

Evidence from the F_3 generation.—Further evidence in support of the single-factor pair difference for green and yellow is offered by the F_3 generation. In order to secure that evidence we studied thirty-four F_3 progenies of the cross *Ce* × *Kon* and thirty-four similar progenies of the reciprocal *Kon* × *Ce*. (See Tables III and IV). There should have been justification to regard all *yellow* segregants of the F_2 as pure breeding for that character. However, in the case of the cross *Ce* × *Kon*, *yellow* segregants were carried through the third generation so that in Table III we will find ten progenies of such segregants. This was not done with the similar segregates in the cross *Kon* × *Ce* According to expectation the F_3 progenies should show a distribution of homozygous green to heterozygous green in the ratio of 1:2. An examination of Table III will reveal that such expectation was very closely realized, the green F_2 plants when carried through the third generation exhibiting a distribution of 8 pure-breeding green to 16 heterozygous individuals. The data in Table IV show a similar agreement with expectation; of 34 F_3 progenies, 23 proved to be heterozygous and 11 homozygous for green; a close approximation to the 2:1 ratio.

The hypothesis of a single-factor difference is further strengthened by the individual behavior in the F_3 of the heterozygous F_2 plants. Of sixteen such progenies in Table III only in family 26 are the results of doubtful significance. There the Dev./P. E. is almost 3.3 and therefore the odds against such a deviation being caused by random sampling are rather high. Whether a 3:1 ratio prevails in that family is not established by those results. All the 23 progenies in Table IV show a fairly good agreement with the expected 3:1 ratio.

From the evidence offered from F_2, B.C. and F_3 generations, a single-factor pair difference is established for *yellow* plant color as contrasted to green. It is proposed that this factor pair be designated *Yy*, green plants to be represented by *YY* and yellow plants by *yy*.

The Ceniza or Glaucous Character

The plants of the first generation crosses were all normal green or *non-glaucous*, indicating dominance of this character over *glaucous* (*Ce*).

In the study of the data on the *Ce* character two phenotypes were easily distinguishable, namely, the *glaucous* and *non-glaucous* and therefore individuals were classified into those two groups. The study of the distribution of the population of the second generation of the direct and reciprocal cross *Ce* × *Kon* and one backcross suggested a ratio of fifteen normal green plants to one "Ceniza" or *glaucous*. Progeny *Ce* × *Kon* — A (Table V) gave 438 normal and 35 *Ce* plants or a ratio of 12.51 to 1 The significance of these results rests on the fact that on the basis of a 15:1 ratio, the Dev./P.E. is only 1.53 Progeny *Kon* × *Ce* — A (Table V) showed a distribution of 128 normal to 10 *Ce* plants. These numbers represent a ratio of 12.8 to 1. On the assumption of a 15:1 ratio the Dev./P.E. is very low, only 0.72. The backcross progeny (*Kon* × *Ce*) × *Ce* given in Table V is represented by 251 normal to 66 *Ce* individuals, a ratio of 3.8 to 1. On the basis of a 3:1 ratio of normal to *Ce* the Dev./P.E. value is 2.55 and therefore such a deviation may be attributed to random sampling. The assumption of a segregation in the ratio of 15 normal to 1 *Ce* in the F_2 seems to be supported by a backcross ratio of 3 normal to 1 *Ce*. Therefore, there are sufficient grounds to assume a *two* factor pair difference between normal and *Ce*, the *Ce* character being exhibited only as the double recessive; and dominance of one or the other, or of both factors, producing normal plants.

Evidence from the second generation.—As proof of the hypothesis of the 15:1 relationship several F_2 progenies other than those reported above, were studied. (See Table V). Of 3 progenies of *Ce* × *Kon* only in B do the results appear to invalidate the hypothesis, with a Dev./P.E. reaching 3.37, slightly above the lower level of significance. But with larger numbers in C and D the results were in fairly good agreement with expectations, the Dev./P.E. being as low as 0.33 and 0.45, respectively. Other F_2 progenies which support the assumed 15:1 ratio are *Kon* × *Ce* — B, *45* × *T*, and *T* × *45*, A and B, and

$T \times Ce$. All these progenies show a good agreement with the expected ratio.

Evidence from the backcrosses.—Additional evidence in support of the expected backcross ratio of 3:1 is furnished by progenies $(45 \times T) \times 45$ and $(T \times 45) \times 45$ which exhibit a D/P.E. of 1.48 and 1.75, respectively, and by $(T \times Ce) \times Ce$ with a D/P.E. = 1.80.

Evidence from the third generation.—If the hypothesis of duplicate genes as an explanation of the results obtained in the F_2 and B.C. generations of crosses involving the study of the *Ce* character holds, it would be expected that in the third generation some progenies should be normal, some should segregate in the ratio of 15:1 and some 3:1, normal to *Ce*; while one out of sixteen should be *glaucous*. That this expectation was realized is evidenced by the data on 20 progenies of the cross $Ce \times Kon$ (Table VI) and 28 progenies of the reciprocal (Table VII). An examination of Table VI reveals that out of 20 progenies, seven segregated in the ratio of 15 to 1, six in the ratio of 3:1, five were pure breeding normal and two were "Ceniza" or *glaucous*. In the segregating families the statistical analysis of the data proves that the results significantly support the assumption of either 15:1 or 3:1 ratios. A similar behavior is obtained in the F_3 of the reciprocal cross (Table VII). There, seven progenies segregated in a ratio of 15 to 1 and six in the ratio of 3:1 normal to *glaucous;* thirteen were pure breeding normal while two were "Ceniza" or *glaucous*. If all the F_3 progenies are considered together the distribution is as follows: 18 progenies pure breeding normal, 14 progenies segregating in the ratio of 15:1, 12 others in the ratio of 3:1, and four homozygous *glaucous*. If the composition of a normal plant be represented by $Ce_1\ Ce_1\ Ce_2\ Ce_2$, the *glaucous* by $ce_1\ ce_1\ ce_2\ ce_2$ and the hybrid in the cross by $Ce_1\ ce_1\ Ce_2\ ce_2$, the following genotypes and ratios would be expected in F_3 on the basis of the 15:1 hypothesis: 1 $Ce_1\ Ce_1\ Ce_2\ Ce_2$, 2 $Ce_1\ Ce_1\ Ce_2\ ce_2$, 1 $Ce_1\ Ce_1\ ce_2\ ce_2$, 2 $Ce_1\ ce_1\ Ce_2\ Ce_2$, 4 $Ce_1\ ce_1\ Ce_2\ ce_2$, 2 $Ce_1\ ce_1\ ce_2\ ce_2$, 1 $ce_1\ ce_1\ Ce_2\ Ce_2$, 2 $ce_1\ ce_1\ Ce_2\ ce_2$, and 1 $ce_1\ ce_1\ ce_2\ ce_2$. Of those with either one or the other factor, or both factors in the dominant condition, $Ce_1\ ce_1\ Ce_2\ ce_2$ would be expected to segregate in the ratio of 15:1, $Ce_1\ ce_1\ ce_2\ ce_2$ and $ce_1\ ce_1\ Ce_2\ ce_2$ in the ratio of 3:1, $ce_1\ ce_1\ ce_2\ ce_2$ would be *glaucous* and all the other genotypes would be pure breeding normal. There would then be expected four classes of genotypes in the following ratios: 7 pure breeding normal, 4

segregating 15:1, 4 segregating 3:1 and 1 pure recessive. When the Chi-square test for goodness of fit is applied to the expected results given above, a value of P = 0.78 is obtained.

Class	Expected Ratio	Frequencies		$\frac{O-C^2}{C}$	P
		Observed	Calculated		
Normal	7	18	21		
15:1 ratio	4	14	12		
3:1 ratio	4	12	12		
Pure Recessive	1	4	3		
Total	16	48	48	1.09523	0.78046

The deviations from the expected ratio of the distribution of the F_3 families are such as might be expected by chance alone eleven times in twenty trials and it may be concluded, therefore, that the results obtained support the suggested hypothesis of duplicate genes.

On the basis of F_2, B.C. and F_3 results it is concluded that the assumption of a 2-factor difference for the *Ce* character is justified. These factors are designated as Ce_1 and Ce_2 with their corresponding allelomorphs ce_1 and ce_2. The presence of either factor in the dominant condition produces normal plants while both factors must be recessive to produce the "Ceniza" character. The constitution of a "Ceniza" plant will be represented by $ce_1\ ce_1\ ce_2\ ce_2$.

Independent Inheritance

It was of interest to determine from the data whether there existed any linkage relations between the factor pair Yy and $Ce_1\ ce_1$ or $Ce_2\ ce_2$. The fact that *N. tabacum* has twenty-four pairs of chromosomes would make the detection of linkage between those factors of unique interest especially since the occurrence of the mutants has been reported from Puerto Rico simultaneously. From the analysis of the distribution of the phenotypes in three F_2 progenies, twelve F_3's and one backcross progeny it appears that no linkage exists between the factor pairs $Ce_1\ ce_1$ and $Ce_2\ ce_2$ and yellow (Yy). The reader is referred to Table VIII. The F_2 progenies *Ce* × *Kon* — C and — D and *Kon* × *Ce* — A, on the basis of independent inheritance of the characters should yield four classes in the following ratios: 45 normal green, 15 normal yellow, 3 *Ce* green and 1 *Ce* yellow. The Chi-square method of testing the goodness of fit showed that for *Ce* × *Kon* — *C*, P = 0.53; for *Ce* × *Kon* — D, P = 0.80 and *Kon* × *Ce* — A, P = 0.52. These values of P all show that the deviations from the expected are not significant.

In the F_3 of the direct and reciprocal crosses of *Ce* × *Kon*, progenies 6, 7, 52, 67, 68 and 76, segregating in the ratio of 3 normal to 1 *Ce* and 3 green to 1 yellow, should show a distribution of phenotypes as follows: nine normal green, 3 normal yellow, 3 *Ce* green and 1 *Ce* yellow. These expectations are realized in all these progenies (see Table VIII). In all these progenies the values of P are high, the lowest being 0.13 for family no. 68. This value, however, indicates that the deviations might be expected to be due to chance alone, once in eight times.

Progenies 30, 55, 62, 66, 71 and 85 which segregated in the ratio of 15 normal to 1 *Ce* and 3 green to 1 yellow, would be expected to show the phenotypes in the same ratios as the F_2 progenies, namely 45:15:3:1. Such expectation is fully accomplished in all the progenies except no. 55. An examination of the distribution of the phenotypes in that progeny, however, shows that the deficiencies may not be attributed to linkage.

The distribution of the genotypes in the F_3 generation is given in Table IX. The normal expectation of genotypes on the basis of a 15:1 ratio for the *Ce* character and 3:1 segregation for green and yellow is as follows. Green genotypes to give only, 7 normal; 4 segregating in the ratio of 15 normal to 1 *Ce*; 4 in the ratio of 3 normal to 1 *Ce*; and 1 pure breeding "Ceniza". Those green individuals of the composition *Yy* should show the following distribution: 14 normal, 8 segregating 15 normal to 1 *Ce*, 8 segregating into 3 normal and 1 *Ce*, and 2 pure breeding *Ce*. The yellow genotypes are not analyzed in the above table, but the expectation would be the same as for pure breeding greens.

A consideration of the results given in Table IX shows that the deviations from the expected ratio are such as can well be attributed to conditions of the experiment.

The results of F_2 and F_3 progenies given in support of the hypothesis of the independent inheritance of the Yy and Ce_1 ce_1 Ce_2 ce_2 are further complemented by the backcross results.

So, from the above results it may safely be concluded that no linkage exists between the factor for *yellow* plant color and those factors responsible for the "Ceniza" or *glaucous* character.

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SUMMARY

1. Two previously undescribed characters of *N. tabacum* are described and studied genetically. The *yellow* plant color appears to be distinct from similar deficiencies heretofore reported. It is not to be confused with the *Burley* character in White Burley tobacco.

2. Green color is dominant to *yellow* color.

3. Normal green is dominant to *glaucous* or "Ceniza".

4. Green and *yellow* are differentiated by a single factor pair which is designated *Yy*.

5. Normal green and *Ce* or *glaucous* plants are differentiated by two factor pairs; therefore segregation occurs in the proportion of 15 normal green to 1 *glaucous* (*Ce*). These are designated by Ce_1 ce_1 Ce_2 ce_2.

6. The factors for *glaucous* and for *yellow* are inherited independently of each other.

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APPENDIX

TABLE I

SEGREGATION OF THE GREEN (Y) AND *YELLOW* (y) CHARACTERS IN THE F_2 OF CROSSES BETWEEN VARIOUS PURE LINES OF TOBACCO

Progeny	Color	n	Frequencies		Dev	P E	D/P. E
			Observed	Calculated (3 1)			
Kon x Ce—A	Green Yellow	461	359 102	345 75 115 25	13 25	6 27	2 11
Kon x Ce—B	Green Yellow	1995	1489 506	1496 25 498 75	7 25	13 08	0 55
Kon x Ce—C	Green Yellow	400	297 103	300 00 100 00	3 00	5 84	0 51
Kon x Ce D	Green Yellow	912	656 256	684 00 228 00	28 00	8 82	3 17
Kon x Ce—E	Green Yellow	824	638 186	618 00 206 00	20 00	8 38	2 39
Kon x Ce—F	Green Yellow	713	536 177	534 75 178 25	1 25	7 80	0 16
Ce x Kon—A	Green Yellow	1150	856 294	862 50 287 50	6 50	9 90	0 66
Ce x Kon—B	Green Yellow	358	279 79	268 50 89 50	10 50	5 53	1 89
Kon x T—A	Green Yellow	4642	3522 1120	3481 50 1160 50	40 50	19 90	2 04
T x Kon—B	Green Yellow	5156	3844 1312	3867 00 1289 00	23 00	20 97	1 10

TABLE II

SEGREGATION OF THE GREEN (Y) AND *YELLOW* (y) CHARACTERS IN THE BACK-CROSS GENERATION OF CROSSES BETWEEN VARIOUS PURE LINES OF TOBACCO

Progeny	Color	n	Frequencies		Dev	P E	D/P E
			Observed	Calculated (1 1)			
(Kon x Ce) x Kon—A	Green Yellow	1797	869 928	898 50 898 50	29 50	14 29	2 06
(Kon x Ce) x Kon—B	Green Yellow	730	398 332	365 00 365 00	33 00	9 11	3 62
(Kon x Ce) x Kon—C	Green Yellow	974	490 484	487 00 487 00	3 00	10 53	0 28
(Kon x Ce) x Kon—D	Green Yellow	141	64 77	70 50 70 50	6 50	4 00	1 62
(Kon x Ce) x Kon—E	Green Yellow	367	184 183	183 50 183 50	0 50	6 46	0 08
(Ce x Kon) x Kon—A	Green Yellow	154	80 74	77 00 77 00	3 00	4 19	0 72
(Ce x Kon) x Kon—B	Green Yellow	362	191 171	181 00 181 00	10 00	6 42	1 56
(Kon x T) x 43	Green Yellow	911	460 451	455 50 455 50	4 50	10 18	0 44
(T x Kon) x 43	Green Yellow	1187	589 598	593 50 593 50	4 50	11 62	0 36

TABLE III

RESULTS OF THE F_2 GENERATION OF THE CROSS *Ct* × *Kon* IN THE STUDY OF THE *YELLOW* CHARACTER

Progeny	Color	n	Frequencies		Dev	P E	D/P E
			Observed	Calculated (3 1)			
2	Green Yellow	996	776 220	747.00 249.00	29.00	9.22	3.15
4	Green Yellow	920	708 212	690.00 230.00	18.00	8.86	2.03
6	Green Yellow	1135	876 259	851.25 283.75	24.75	9.84	2.52
7	Green Yellow	470	359 111	352.50 117.50	6.50	6.33	1.03
8	Green Yellow	483	373 110	362.25 120.75	10.75	6.42	1.67
10	Green Yellow	144	115 29	108.00 36.00	7.00	3.50	2.00
13	Green Yellow	517	393 124	387.75 129.25	5.25	6.64	0.79
21	Green Yellow	1353	1033 320	1014.75 338.25	18.25	10.71	1.70
25	Green Yellow	158	120 38	118.50 39.50	1.50	3.67	0.41
26	Green Yellow	689	54 14	516.75 172.25	25.25	7.67	3.29
31	Green Yellow	459	363 96	344.25 114.75	18.75	6.26	2.99
32	Green Yellow	333	241 92	249.75 83.25	8.75	5.33	1.64
33	Green Yellow	1250	966 284	937.50 312.50	28.50	10.30	2.77
34	Green Yellow	202	150 52	151.50 50.50	1.50	4.16	0.36
44	Green Yellow	406	315 91	304.50 101.50	10.50	5.88	1.79
46	Green Yellow	751	560 191	563.25 187.75	3.25	8.00	0.41

Families breeding true to green 1 5 9 14 20 23 45 and 47

Families breeding true to yellow 15 16 17 18, 19 39 40 41 42 and 43

TABLE IV

BEHAVIOR OF THE F_3 GENERATION OF THE CROSS *Kon* × *Ce* IN THE STUDY OF THE *YELLOW* CHARACTER

Progeny	Color	n	Frequencies Observed	Frequencies Calculated (3:1)	Dev D	P E	D/P E
52	Green Yellow	585	445 140	438 75 146 25	6 25	7 06	0 89
54	Green Yellow	376	291 85	282 00 94 00	9 00	5 66	1 59
55	Green Yellow	1016	772 244	762 00 254 00	10 00	9 31	1 07
56	Green Yellow	492	373 119	369 00 123 00	4 00	6 48	0 62
61	Green Yellow	761	566 195	570 75 190 25	4 75	8 06	0 59
62	Green Yellow	759	570 189	569 25 189 75	0 75	8 05	0 09
63	Green Yellow	439	335 104	329 25 109 75	5 75	6 12	0 94
66	Green Yellow	452	339 113	339 00 113 00	0	6 21	0
67	Green Yellow	405	302 103	303 75 101 25	1 75	5 88	0 30
68	Green Yellow	416	318 98	312 00 104 00	6 00	5 96	1 01
69	Green Yellow	497	375 122	372 75 124 25	2 75	6 51	0 42
70	Green Yellow	435	332 103	326 25 108 75	5 75	6 09	0 94
71	Green Yellow	325	253 72	243 75 81 25	9 25	5 27	1 70
72	Green Yellow	213	153 60	159 75 53 25	6 75	4 26	1 58
76	Green Yellow	208	154 54	156 00 52 00	2 00	4 21	0 48
77	Green Yellow	208	155 53	156 00 52 00	1 00	4 21	0 24
79	Green Yellow	260	202 58	195 00 65 00	7 00	4 71	1 49
85	Green Yellow	360	270 90	270 00 90 00	0	5 54	0
87	Green Yellow	359	284 75	269 25 89 75	14 75	5 53	2 67
88	Green Yellow	248	191 57	186 00 62 00	5 00	4 60	1.09
89	Green Yellow	266	210 56	199 50 66 50	10 50	4 76	2 20
90	Green Yellow	549	428 121	411 75 137 25	16 25	6 84	2 38
91	Green Yellow	196	149 47	147 00 49 00	2 00	4 09	0 49

Families breeding true to green 53 57 58, 59 60, 64, 65 74, 78, 81 and 83

TABLE V

SEGREGATION OF THE CENIZA (ce) OR *GLAUCOUS* CHARACTER AND THE NORMAL CHARACTER (Ce) IN THE SECOND AND BACKCROSS GENERATIONS OF CROSSES

Progeny	Color	n	Frequencies: Observed	Calculated: n	Calculated: ratio	Dev.	P.E.	D/P.E.
Ce x Kon—A	Normal	473	458	443.44	15:1	5.44	3.55	1.53
	Ceniza		15	29.56				
Ce x Kon—B	Normal	451	411	422.71	15:1	11.71	3.47	3.37
	Ceniza		40	28.29				
Ce x Kon—C	Normal	997	933	934.69	15:1	1.69	5.16	0.33
	Ceniza		64	62.31				
Ce x Kon—D	Normal	981	922	919.69	15:1	2.31	5.11	0.45
	Ceniza		59	61.31				
Kon x Ce—A	Normal	138	128	129.38	15:1	1.38	1.92	0.72
	Ceniza		10	8.62				
Kon x Ce—B	Normal	181	167	169.69	15:1	2.69	2.20	1.22
	Ceniza		14	11.31				
45 x T	Normal	85	81	79.69	15:1	1.31	1.51	0.87
	Ceniza		4	5.31				
T x 45—A	Normal	246	229	230.62	15:1	1.62	2.56	0.63
	Ceniza		17	15.38				
T x 45—B	Normal	210	199	196.87	15:1	2 2	2.37	0.90
	Ceniza		11	13.12				
T x Ce	Normal	292	266	273.75	15:1	7.75	2.69	2.88
	Ceniza		26	18.25				
(T x Ce) x Ce	Normal	379	274	284.25	3:1	10.25	5.69	1.80
	Ceniza		105	94.75				
(Kon x Ce) x Ce	Normal	317	251	237.75	3:1	13.25	5.20	2.55
	Ceniza		66	79.25				
(45 x T) x 45	Normal	66	53	49.50	3:1	3.50	2.37	1.48
	Ceniza		13	16.50				
(T x 45) x 45	Normal	175	138	131.25	3:1	6.75	3.86	1.75
	Ceniza		37	43.75				

TABLE VI

BEHAVIOR OF THE F_3 PROGENIES OF THE CROSS *Cs* × *Kon* IN THE STUDY OF THE *CENIZA* OR *GLAUCOUS* CHARACTER

Progeny	Color	n	Frequencies			Dev.	P. E.	D/P. E.
			Observed	Calculated				
				n	ratio			
17	Normal Ceniza	137	133 4	128 440 8 560	15:1	4 560	1 91	2.39
18	Normal Ceniza	34	31 3	31 880 2 120	15:1	0 880	0.95	0.93
19	Normal Ceniza	55	51 4	51 560 3 440	15:1	0.560	1 21	0.46
23	Normal Ceniza	130	122 8	121 875 8 125	15:1	0.125	1 86	0.07
30	Normal Ceniza	120	114 6	112 500 7 500	15:1	1 500	1 79	0.84
40	Normal Ceniza	128	122 6	120 000 8 000	15:1	2 000	1.85	1 08
42	Normal Ceniza	128	123 5	120 000 8 000	15:1	3 000	1 85	1 62
5	Normal Ceniza	246	181 65	184 500 61 500	3:1	3 500	4.58	0.76
6	Normal Ceniza	175	138 37	131 250 43 750	3:1	6.750	3 86	1 75
7	Normal Ceniza	153	111 42	114 750 38.250	3:1	3 750	3 61	1 04
16	Normal Ceniza	153	141 12	143 440 9 560	3:1	2 440	3 61	0.68
25	Normal Ceniza	120	94 26	90 000 30 000	3:1	4 000	3.20	1 25
32	Normal Ceniza	120	96 24	90 000 30 000	3:1	6 000	3 20	1 87

Families breeding true to normal: 4, 9, 15, 26 and 33.

Families breeding true to "Ceniza" or *glaucous*: 39 and 43.

TABLE VII

BEHAVIOR OF THE F_3 PROGENIES OF THE CROSS *FON* x *CE* IN THE STUDY OF THE CENIZA OR *GLAUCOUS* CHARACTER

Progeny	Color	n	Frequencies			Dev	P E	D/P. E.
			Observed	Calculated				
				n	ratio			
55	Normal Ceniza	365	334 31	342 19 22 81	15 1	8 19	3 12	2.62
62 ..	Normal Ceniza	282	264 18	264 32 17 62	15 1	0 37	2 74	0 14
65	Normal Ceniza	311	299 12	291 56 19 44	15 1	7 44	2 88	2 58
66	Normal Ceniza	448	421 37	420 00 28 00	15 1	1 00	3 46	0 29
71	Normal Ceniza	308	281 27	288 75 19 25	15 1	7 75	2 87	2 70
85	Normal Ceniza	286	268 18	268 13 17 87	15 1	0 13	2 76	0 05
91	Normal Ceniza	149	142 7	139 69 9 31	15 1	2 31	1 99	1 16
52	Normal Ceniza	401	319 82	300 75 100 25	3 1	18 25	5 85	3 12
58	Normal Ceniza	327	258 69	245 25 81 75	3 1	12 75	5 28	2 41
67	Normal Ceniza	380	287 93	285 00 95 00	3 1	2 00	5 69	0 35
68	Normal Ceniza	406	313 93	304 50 101 50	3 1	8 50	5 88	1 45
76 .	Normal Ceniza	198	155 43	148 50 49 50	3 1	6 50	4 11	1 58
83	Normal Ceniza	252	201 51	189 00 63 00	3 1	12 00	4 64	2 59

Families breeding true to normal 53, 57, 60, 63, 64, 69, 70, 72, 77, 78, 79, 89 and 90

Families breeding true to "Ceniza" 59 and 61.

TABLE VIII

SHOWING PHENOTYPIC DISTRIBUTION IN F_2, F_3 AND B. C. PROGENIES OF CROSSES IN THE STUDY OF THE *YELLOW* AND CENIZA CHARACTERS

Progeny	Class *	Frequencies			Chi Square	P
		Observed	Calculated			
			ratio	n		
Ce x Kon—C.......... ...	NY... ...	703	45	701 0160		
	Ny.	230	15	233.6720		
	nY... .. .	43	3	46.7840		
	ny	21	1	15.5780		
	Total .. .	997	....	997.0000	=2 24376	0.53
Ce x Kon—D........... .	NY. . ..	693	45	689 7660		
	Ny	229	15	229.9220		
	nY ...	41	3	45 9840		
	ny	18	1	15 3280		
	Total....	981	. .	981 0000	=1.[illegible]484	0 80
Kon x Ce—A.....	NY .	100	45	97.0810		
	Ny	28	15	32 3440		
	nY. .	9	3	6 4688		
	ny	1	1	2 1562		
	Total....	138	....	138.0000	=2 28431	0.52
Ce x Kon—6.............	NY..... .	94	9	98.4375		
	Ny........	44	3	32 8125		
	nY.. . .	29	3	32.8125		
	ny	8	1	10 9375		
	Total. . .	175	..	175 0000	=5 24636	0.16
Ce x Kon—7	NY ..	81	9	86 0625		
	Ny	30	3	28 6875		
	nY.. .	35	3	28 6875		
	ny . ..	7	1	9 5625		
	Total ...	153	.. ..	153 0000	=2 43355	0 49
Ce x Kon—30...	NY... . .	49	45	42.1875		
	Ny . .	8	15	14 0625		
	nY . .	2	3	2 8125		
	ny... ...	1	1	0.9375		
	Total.....	60	. .	60.0000	=3.95250	0.27
Kon x Ce—55.............	NY.......	226	45	256 6410		
	Ny........	119	15	85 5470		
	nY........	12	3	17.1090		
	ny........	8	1	5.7030		
	Total.....	365	.. .. ..	365 0000	=19.19081	0.0003
Kon x Ce—62.............	NY.......	196	45	198 2810		
	Ny.... ...	68	15	66 0940		
	nY........	12	3	13.2190		
	ny........	6	1	4.4060		
	Total....	282	....	282 0000	=1.36496	0.74
Kon x Ce—66.............	NY.......	322	45	315.0000		
	Ny........	90	15	105 0000		
	nY........	22	3	21 0000		
	ny........	5	1	7.0000		
	Total.....	448	....	448.0000	=1.11746	0.77

*The class *NY* stands for normal green, *Ny* is normal yellow, *nY* is ce, or *glaucous* green, and *ny* represents ce yellow.

TABLE VIII—(Cont)

SHOWING PHENOTYPIC DISTRIBUTION IN F_2, F_3 AND B C PROGENIES OF CROSSES IN THE STUDY OF THE *YELLOW* AND CENIZA CHARACTERS

Progeny	Class *	Frequencies: Observed	Frequencies: Calculated ratio	Frequencies: Calculated n	Chi Square	P
Kon x Ce—71	NY	217	45	216 5620		
	Ny	64	15	72 1870		
	nY	22	3	14 4840		
	ny	5	1	4 8130		
	Total	308		308 0000	=4 89732	0 18
Kon x Ce—85	NY	186	45	201 0940		
	Ny	82	15	67 0310		
	nY	13	3	13 4060		
	ny	5	1	4 4690		
	Total	286		286 0000	—4 55113	0 21
Kon x Ce—52	NY	223	9	225 5620		
	Ny	96	3	75 1870		
	nY	59	3	75 1880		
	ny	23	1	25 0630		
	Total	401		401.0000	=9 44557	0 24
Kon x Ce—67	NY	207	9	213 7500		
	Ny	80	3	71 2500		
	nY	72	3	71 2500		
	ny	21	1	23 7500		
	Total	380		380 0000	=1 61408	0 66
Kon x Ce—68 . ..	NY	239	9	228 3750		
	Ny	74	3	76 1250		
	nY	79	3	76 1250		
	ny	14	1	25 3750		
	Total	406		406 0000	=5 76136	0 13
Kon x Ce—76	NY	123	9	111 3750		
	Ny	32	3	37 1250		
	nY	31	3	37 1250		
	ny	12	1	12 3750		
	Total	198		198 0000	- 2 94275	0 40

TABLE IX

BEHAVIOR OF GENOTYPES IN RELATION TO THE *CE* CHARACTER OR ITS ALLELOMORPH IN F_3 FAMILIES WHICH ARE PURE BREEDING FOR GREEN OR SEGREGATING FOR GREEN AND YELLOW

Class		Calculated ratio	n		Chi Square	P
			Observed	Calculated		
Green	Normal	7	6	5 250		
	15 1	4	2	3 000		
	3 1	4	3	3 000		
	ce	1	1	0 750		
	Total	16	12	12 000	=0 52380	Over 0 80
Segregating Green & Yellow	Normal	14	11	11 375		
	15 1	8	6	6 500		
	3 1	8	8	6 500		
	ce	2	1	1 625		
	Total	32	26	26 000	=0 63734	Over 0 80

THE UTILIZATION OF WASTE MOLASSES IN THE PRODUCTION OF

I. ACETONE AND BUTANOL
II. NORMAL BUTYRIC ACID

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INTRODUCTION

The industrial world has felt the influence of fermentation processes, especially during the past thirty years; and is beginning to realize the tremendous significance of the application of industrial microbiology in the development of useful chemicals from cellulose, starch and sugars.

The microbiological flora of the tropics is rich in organisms capable of industrial utilization, and the industry of the sugar cane offers abundant and inexpensive material, that may become the basis of great future industries. In the writer's opinion, carbo-hydrate nations are destined to exercise a controlling role in human affairs through chemical synthesis and fermentation processes.

This paper treats of two such processes, and will be divided in two parts; the first dealing with the production of Acetone and Butanol from waste molasses, and the second with that of normal butyric acid from the same source. While the first part embodies the account of a finished piece of industrial research (in so far as laboratory work is concerned) that was started during July, 1931; the second presents the progress made to date in a new investigation initiated only a few months ago. This fact will account for the lack of definite data in the subject matter of part two.

PART I

BUTANOL AND ACETONE FROM WASTE MOLASSES

The Necessity of Industrial Research in the Industry of the Sugar Cane.—While there exists no single great industry more needful of industrial research than that of the sugar cane, there is none showing less interest and progress in this respect. There have existed several reasons for this attitude, a discussion of which lies beyond the scope

of this article. But whatever reasons existed in the past for this apathetic attitude towards industrial research, they are no longer tenable under the existing general conditions of this great industry. Millions are being wasted every year in the form of unutilized by-products and waste materials while the price of the main product drops to unprofitable levels. It seems that those responsible for the wastes are so close to them that they have come to regard them as unavoidable accompaniment of the industry. Meanwhile the dextrose industry has become a serious competitor, and the commercial production of Levulose promises a still stronger future rival. At the same time the technical world hears of sugar from wood waste in Sweden and Germany, and sugar again, from potatoes in Ireland. Is the cane-sugar industry to remain in the worn-out traditional channels, blind and oblivious to the "New Era" that will revolutionize the world through carbohydrate chemistry?

Possibility of Producing Butanol and Acetone from Waste Molasses.—With a determined purpose of doing his share (no matter how small and inadequate) for the amelioration of this existing trend of affairs, and with a deep rooted conviction that if the sugar industry is going to servive its present crisis, new products must be manufactured either from sugar itself or its by-products, the writer started his investigation on the problem of the fermentation of final molasses for the production of butanol and acetone. From his search of the literature the writer knew of no existing fermentation process of commercial magnitude for the production of these solvents from Waste Molasses, at the time of the commencement of his investigation, July 1931.

Searching for the Fermenting Organism.—Having learned from the literature on this subject that the organisms responsible for the acetone-butylic fermentation of carbohydrate material were widely distributed in nature, the writer decided to try as possible sources such things as soil, decaying vegetable matter, potatoes, sweet potatoes, beets, and sugar cane. For the culture medium, a dilute solution of final molasses in water was selected, with such chemical and physical modifications as would best suit the growing and development of the given organism and its power for the production of solvents. The word "Solvents" is used throughout this work to include all the valuable liquid products of fermentation.

The molasses solution was placed in test tubes of about 50 ml. capacity, and inoculated in each case directly with small pieces of the material suspected of containing the butyl-bacillus. After incuba-

tion for a period of from 36 to 48 hours, the presence of butanol was to be detected first hand, by that most chemical of human senses, the s nse of smell. If the characteristic butanol scent could be detected, then further work was to be done to isolate the organism and set it to work under conditions favorable to its growth, developm nt and solvents producing power.

The preliminary work as described above was conducted without success in the great majority of cases; the potatoes, sweet potatoes, and the soils in which they grew giving negative results. The writer reached the conclusion that either these materials did not contain the butyl bacillus, or else, the strains contained in any or all of them could not be grown and developed in the culture medium selected for this work.

The search for the organism was then started among the sugar cane varieties grown in Puerto Rico; and this time luck came to help out the writ r's labors. Not less than 50 different varieties and the soil around their roots were examined, and in a little over 20 per cent of these, the organism was found. However, not all of them showed the same characteristics, ability to grow, develop and produce the requir d solvents in the chosen medium. The apparently most promising strains were obtained from the following canes:—POJ-2725; 2883; 2873; 979; 1228; FC-588: 916; 998; and PR-820 and 807. But the only one that convinced the writer of possessing very remarkable power for doing the work, was a strain obtained from the roots of a cane of the Kassoer variety.

Having thus obtained promising material, the writer proceeded to the work of purification and isolation of the bacillus. This work will be described in the next paragraph.

Isolation of the Bacillus in Pure Culture.—The bacillus found on the roots of the Kassoer cane was isolated as follows: A set of 12 test tubes each containing 10 ml. of sterile mash of 4 deg. Brix density, were inoculated with small amounts of the unsterilized cane roots. The tubes were then immersed in boiling water for 50 seconds and immediately cool d in running water. They were then incubated for 36 hours and examined for odor and gas production. The tube showing most vigorous fermentation and strongest butyl odor was chosen, and further incubated until fermentation was completed; reheated in boiling water, cooled, and the contents plated in malt gelatine agar. After inoculation of the malt gelatine agar, the medium was poured into the inverted lid of a sterile Patri dish, and the bottom section of the dish was then floated on the liquid. After incubation the two

parts of the plate were easily separated and the colonies fished. These colonies were used for further propagation as found necessary.

Adapting the Medium to the Bacillus.—Lack of inverting power and inability to attack sucrose for the production of solvents were soon discovered in the bacillus. The bacillus, on the other hand, readily attacked and decomposed reducing sugars with the production of the desired solvents. Hence the sucrose in the molasses used for making up mashes was always inverted before inoculation.

After some experimental work details of which would occupy too much space, the conclusion was reached to make the mashes according to the procedure described below, calling this mash "The Standard Mash".

Ninety grams final molasses were weighed into a two liter Erlenmeyer flask, four hundred ml. distilled water added and the molasses dissolved by heating on a water bath with occasional shaking. When solution was effected, 1.5 ml. strong sulphuric acid were added, and the flask was autoclaved during half hour at 20 pounds pressure to effect inversion. After cooling to about 50 deg. C., five and a half grams of calcium carbonate, and 1.5 ml. strong ammonia water were added to the mash in the flask. When effervescence subsided, the mash was completed to 1,800 ml. with distilled water, plugged with non-absorbent cotton, and again autoclaved for half hour at 20 pounds pressure. When thus prepared, this standard mash gave a reading of 90 mv. at the potentiometer, equivalent to pH–6. Any small variation from a potentiometer reading of 90 mv. was corrected by addition of hundredth normal sulphuric acid or sodium hydroxide; as found necessary. The bacillus worked very satisfactorily in this medium.

Fermentation Tests.—Many fermentation tests using the pure culture obtained and the standard mash prepared as described above were conducted at various temperatures, ranging from 30 to 40 deg. C. to ascertain the optimum temperature of fermentation. Results of those tests showed that the optimum temperature for a successful fermentation was 35 deg. C. At this temperature the greatest yield of solvents was obtained, fermentation being completed in from 48 to 54 hours after its initiation. When working at temperatures above 35 deg., C. it was found that fermentation was rapid and vigorous; but the yield of total solvents was less than when working at 35 deg. C., while the ratio of acetone to butanol was higher. At 39 deg. C. the organism worked very briskly for some time but all action soon ceased, and when examined under the microscope the bacilli had ap-

parently lost their characteristic motility, very few vegetative cells being observed When temperatures from 30 to 35 deg. C. were used the fermentation was rather sluggish, and instead of from 48 to 54 hours, it took from 60 to 72 hours to complete it. The table on next page shows the influence of temperature during the fermenting period.

TABLE SHOWING THE EFFECT OF TEMPERATURE DURING FERMENTATION

% T S = PERCENT TOTAL SOLVENTS

Test No	Temperature of Fermentation Deg C	Time of Active Fermentation Hours	Analysis of Products				Ratio of Butanol to Acetone	
			T S %	Butanol %	Acetone %	Ethanol %		
1	30	70	23.50	17.82	4.95	0.73	3.6	I
2	31	66	24.05	18.00	5.00	1.05	3.6	I
3	32	63	24.50	18.28	5.07	1.15	3.6	I
4	33	60	25.80	19.31	5.51	0.98	3.5	I
5	34	57	27.10	20.27	5.78	1.05	3.5	I
6	35	49	29.50	21.98	6.27	1.27	3.5	1
7	36	45	27.65	20.07	6.08	1.50	3.3	I
8	37	38	24.49	17.54	5.68	1.28	3.1	I
9	38	32	18.90	12.98	4.99	0.93	2.6	I
10	39	25	12.00	7.57	3.78	0.65	2.0	I

The above figures show that the optimum temperature for fermentation is 35 deg C, that below this temperature fair results may be obtained down to about 32 deg C and up to about 37 deg. C. Temperatures above 37 deg C give very poor results as to total yields and butyl alcohol-acetone ratio, while temperatures below 32 deg C. though not giving very bad yields, take too long to finish fermentation

Acidity of Mashes—The acidity of all mashes was controlled by pH determinations using the potentiometer and quinhydrone electrode. Having found that the bacillus worked best under slightly acid conditions, the initial pH of all mashes was regulated to a reading of 90 mv as stated previously when describing the "STANDARD MASH".

An experiment was run to determined the variations in acidity during and upon completion of fermentation.

During a normal fermentation at optimum temperature, it was observed that the mv. reading rose steadily as soon as fermentation started, continuing this rise during the first 22 or 24 hours, when a potentiometer reading of about 160 mv. could be observed. After this concentration of acidity was reached, the mv. readings started to yield descending values till a constant or nearly constant value of from 125 to 130 mv. was obtained which remained so until fermentation stopped.

In cases of a poor fermentation test due to contamination of the inoculum, or of the mash after inoculation, or to any other inhibiting force, the acidity continued to rise going up to readings between 190 and 210 mv. Every time that this happened, poor yields of solvents were to be expected; examination of a sample under the microscope showing less motility of the organism, signs of contamination; and in extreme cases the organism disappeared altogether from the field of vision.

Thus the determination of pH values periodically (say every 2 or 3 hours) proved to be an excellent control, as an abrupt rise in mv. readings was a sure indication of forecoming trouble. The following curves show the rise in pH during a (1) normal, vs. a poor (2) fermentation.

The following table offers some figures obtained from fermentation test conducted at optimum temperature using "Standard Mash".

DATA

Hour and date of inoculation........................ 10 A. M. Oct. 1, 1931
Hours after inoculation at which fermentation started.... 4 hours
Date of completion of fermentation........................ 3 P. M. Oct. 3, 1931
Hours of active fermentation........................ 53
Incubating temperature........................ 35 deg. C.

Mash No.	Starting Bx.	Final Bx.	Starting Mv	Final Mv	S. G. of Distillate at 30/4 C.	% T S	% Butanol	% Acetone
1	4 60	2 7	95	152	0 9940	20 55	15 88	4 55
2 ...	4 70	2 7	93	155	0 9937	22 27	16.65	4 60
3 ...	4 60	2 3	88	130	0 9928	30 70	22 64	6 40
4	4 60	2 5	90	153	0 9940	20 55	16 00	4 40
5 ..	4 60	2 2	89	125	0 9922	31 36	22 76	6 60
6...	4 70	2 4	87	132	0 9930	26 33	19 22	5 89
7 ..	4 65	2 6	93	142	0 9935	23 20	17 59	4 35
8	4 60	2 6	89	151	0 9937	22 27	17 24	3 98
9...	4 60	2 6	85	145	0 9938	21 82	16 42	3 87
10.	4 60	2 4	86	135	0 9933	24 44	18.19	4 92

NOTE: — The percentage ethanol produced may be found by subtracting from % T. S. the sum of the percentages of butanol & acetone.

Determination of Optimum Sugar Concentration.—From an industrial point of view it was thought very important to determine the optimum sugar concentration in the mash at which the organism would work efficiently.

A series of 12 mashes varying in sugar concentration from 3.65 g. of total sugar to 11.25 grams per 100 ml. of mash were inoculated with the organism, using the same seed for all. After completion of the incubation period, the following results were obtained:

Mash No	Concentration of T Sugars Grams per 100 ml	No of hours to complete Fermentation	Temp of Ferm 35 deg C	% Total Solvents on wt of sugars	% Acetone on wt. of sugars
1	3 65	48	"	24 75	5 21
2	4 25	48	"	27 74	6 09
3	4 55	50	"	27 30	6 12
4	4 85	50	"	27 12	6 22
5	5 14	52	"	22 85	5 20
6	5 45	60	"	10 10	2 50
7	5 75	66	"	7 39	2 00
8	6 05	72	"	4 18	1 15
9	7 25	80	"	1 72	0 65
10	8 50	No ferment			
11	9 75	" "			
12	11 25	" "			

From a study of the data in the above table, it is apparent that best results are obained when working with sugar concentrations of from 4.25 to 4.85 grams per 100 ml. of mash. Fair results may be obtained with concentrations of 3.65 and 5.14 grams of sugar per 100 ml. of mash; but the commercial optimum would be attained when working with a concentration of 4.85 grams of sugar per 100 ml. of mash. With this concentration every 100 ml. of mash will yield on distilling 1.315 gram of total solvents or about 1.65 c. c. It may be observed that mashes Nos. 2 and 5 give slightly higher yields per sugar unit; but having lower concentrations, the actual weights of solvents obtained per 100 ml. of mash are smaller. Also the plant capacity for fermentation and distillation would have to be larger if these concentrations were used commercially. The yields in grams and ml. of solvents per 100 ml. of mash in the cases of the best three concentrations as represented by mashes Nos. 2, 3, and 4 follows:

Mash No	Grams T S per 100 ml of mash	Ml. total solvents per 100 ml of mash
2	1 18	1 48
3..	1 24	1 55
4	1 315	1 65

Activating Agents.—Another fermentation test was run to find the effect of Lamp-Black and Kieselguhr when used in the preparation of the mash separately, and together, in varying proportions. The results obtained are shown in the table below:

TOTAL WEIGHT OF ALL MASHES 1000 GRAMS

Mash No	% T Solids on Wt of Mash	% T Sugars on Wt of Mash	Lamp-Black used Grams	Kieselguhr used Grams	Total Solvents	% Butanol
1	8 8	4 85			24 60	19 07
2	"	"	1		26 50	21 19
3	"	"	2		28 50	23 05
4	"	"	3		25 10	19 41
5	"	"	4		24 60	18 68
6	'	"	5		22 00	16 17
7	"	"		1	27 70	21 68
8	"	"		2	27 70	21 85
9	"	"		3	25 10	19 10
10	"	"		4	25 10	18 95
11 . .	"	"		5	25 10	18 87
12 . . .	"	"	1	1	27 80	23 00
13	"	"	2	2	30 00	25 41
14	"	"	3	3	28 70	23 01
15	"	"	4	4	30 00	24.40
16...	"	"	5	5	30 00	24 25

A perusal of the table on page 15 will reveal at a glance the beneficial effect obtained by the use of the activating agents discussed on that page. The effect is more striking when using both Lamp-Black and Kieselguhr together. In case when Lamp-Black is used alone, the maximum increase in yield of solvents is obtained by using 2 grams of this substance; and this increase amounts to 3.9 per cent on the weight of sugars in the mash or 15.86 per cent over the yield obtained when no activating agent is used. Using quantities much above this maximum give very little increase, no increase, or even deleterious results; for instance, when 5 grams lamp-black were used the yield of solvents was actually less than when using no activating agent at all. In the case of Kieselguhr alone the maximum increase was obtained when using either 1 or 2 grams of the substance; no further increase being obtained by using larger amounts. In this case the increase in yield amounts to 3.10 per cent on the weight of sugars, or 12.6 per cent over the yield obtained without using activating agents. A maximum yield is obtained when using both activating substances together in the proportion of two grams of each; and in this case the increase amounts to 5.40 per cent on the weight of sugars, or 21.81 per cent over results obtained when using no activating agents.

These results show that in a commercial process it would pay to use these activating substances, as the increase in yields are remarkable, especially when using both activating substances together.

Industrial Possibilities.—The writer's opinion is that the Bacillus ACETOBUTYLICUM discovered and isolated by him could have profitable industrial application; and this opinion is based on the following facts:

1. So far there exists no large scale production of these solvents using FINAL SUGAR HOUSE MOLASSES as the raw material.

2. Final molasses is to-day the cheapest carbohydrate source in the market, its price in Puerto Rico being about 3.5 cents a gallon, delivered at the various mills. A gallon of Puerto Rican final molasses contains an average of six pounds total sugars.

3. This bacillus is able to produce more yield of solvents per unit of sugar content of the fermenting medium than any other known so far.

4. The bacillus which is most widely used commercially to-day is that of WIEZMANN, and it produces butyl alcohol, acetone, and ethyl alcohol in the ratio 6:3:1, respectively using corn mash. This bacillus has not been able to produce these solvents profitable from mo-

lasses mash. The writer's bacillus produces these same solvents in the ratio 14:4:1, respectively, using final molasses mash of from 8 to 9 deg. Brix, corresponding to a sugar concentration of from 4.5 to 5.0 per cent.

5. The maximum actual laboratory yield obtained from 1 gallon FINAL MOLASSES by the writer has been:

Total solvents	30.00 per cent;	or 1.95 pounds
Butyl alcohol	22.31 per cent;	or 1.45 pounds
Acetone	6.15 per cent;	or 0.40 pounds
Ethyl alcohol	1.54 per cent;	or 0.10 pounds

The present average market value of the above products, per pound, are 10, 9, and 4 cents, respectively, for butyl alcohol, acetone and ethyl alcohol. There are good reasons to believe that these prices are at about the lowest possible level and that there exists great probability of a future rise in all of them. Even at these low prices, a gallon of sugar factory final molasses would yield a gross value of 18.5 cents when used in the production of these solvents. The actual total cost of production should not exceed 10 cents per gallon of molasses worked up, including all expenses. These expenses may be lowered considerably by working the process as an adjunct to a sugar factory, where cheap fuel in the form of bagasse would be available and where no transportation charges would have to be paid on the molasses used.

Patent applied for by author.

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PART II

NORMAL BUTYRIC ACID FROM WASTE MOLASSES

***Butyric Acid is a Valuable and Important Acid.*—Butyric acid is one of the most valuable aliphatic acids used commercially. Its steady price offers a striking contrast with the declining values that have been prevalent in the market for chemical products during the last four or five years. The present carload price in the United States for this commodity is 80 cents per pound on the basis of 100 per cent acid.**

This attractive price led us to investigate the possibility of producing this organic acid from cane factory waste molasses by microbiological methods. The success obtained in our previous investigation on the production of butanol and acetone by similar methods, encouraged us to try this new study.

Difficulties Encountered by Previous Investigators.—Although fermentation processes leading to the production of organic acids have been practiced before the beginning of civilization, the mechanism whereby these processes took place on the agents responsible for them were utterly ignored. The production of butyric acid, the agent responsible for rancid butter, remained in the situation common to all these processes until Pasteur recognized the butyric fermentation as a well defined microbiological phenomenon; describing this fermentation as an anaerobic process before the Academy of Science in Paris, 1861.

Since this date, many groups of these organisms have been found. and their products of fermentation studied by several well-known investigators, among which we may mention Kirov; Baier; Fitz; Winogradsky; Buchner and Meisemheimer. These men of science agreed in that the formation of butyric acid by fermentation when using the organisms known to them, was generally accompanied by secondary reactions, producers of a variety of other substances. For instance, Buchner and Meisenheimer, when working with the "Bacillus Butyricus" Fitz, found the following products as typical of the fermentation of 100 grams glucose:—0.7 grams butanol; 2.8 grams ethanol; 1.6 grams hydrogen; 3.4 grams formic acid; 10 grams lactic acid; 7.5 grams acetic acid; and 26 grams butyric acid.

Recently, the chemists H. T. Herrick and O. E. May of the Department of Agriculture, Washington, D. C., published a circular on the production of organic acids by fermentation in which they opined that the butyric fermentation has not been applied industrially in commercial magnitude due to the great variety of substances, other than butyric acid produced during the fermentation.

The patent literature describes some processes which give the impression that the work has been done in decidedly empirical form. In some cases it is really difficult to understand how a patent could be secured on such vague, indefinite and entirely unscientific data.

Attacking the Problem.—Having acquired from the literature a knowledge of the butyric fermentation, whose synopsis is given above, we resolved to attack the problem of butyric acid production from waste or "final" sugar factory molasses, using a native bacillus.

The Bacillus is Found.—At the time of our determination to work on the butyric fermentation, we were preparing a series of extracts from the Annatto Seed (Bixa Orellana) that were to be sent to the Chicago Fair. A few seeds left over the week end in a test tube with distilled water to which a little sodium carbonate had been added, were found on next Monday morning in a very active state of fermentation On further examination it was found that the fermenting liquid had turned from an alkaline to a decided acid reaction Moreover, a strong butyric acid scent could be noticed. We had found the organism needed for our intended work on waste-molasses

Our Preliminary Work—We had learned from the experience of previous workers in this field, that the problem of the commercial production of butyric acid by microbiological methods would be practically solved with the discovery of a fermenting organism capable of producing the desired fermentation free of the secondary products obtained when working with organisms already known.

Hence, our greatest interest, once the bacillus was found, was to find out whether or not the organism would satisfy the requirements as to yield and purity of the main product of fermentation. So, as soon as we had enough quantity of the product, an analysis was made to determine its degrees of purity. The results were so highly satisfactory that a duplicate sample was sent to the Bureau of Chemistry of the Department of Agriculture, Washington, D. C. The sample was sent in the form of the barium salt of the acid. The report received from that Department stated that the product was practically entirely butyrate of barium, and that the free acid showed a high degree of purity.

These results were, of course, sufficient to give a great technical and commercial interest to our bacillus; for we had learned that the inhibiting factor militating against their commercial application, was the heterogenous product of fermentation found when working with other butyric ferments.

Other Pertinent Facts Found to Date.—As stated in our introduction this investigation is merely starting, so no definite data is available as yet. But from what has been done to date, the following additional facts may be stated:

1. The organism is exceptionally vigorous, and has shown itself capable of competing with other organisms that may gain access to the fermenting liquid. This may indicate that an absolutely pure culture is not indispensable for the growth, development, and acid production of the organism. From a commercial standpoint this is

an important factor favoring the organism; for the difficulties encountered in plant work in the prevention of contaminations in pure cultures are only too well known.

2. The organism is facultative anaerobic. This is another point of great technical importance, for strict anaerobes bring great difficulties of a technical nature, besides complications of equipment when an effort is made towards their commercial exploitation.

3. We have not determined as yet the optimum conditions of fermentation, nor the maximum obtainable yields of acid; but in the preliminary tests effected up to this time, the yields of acid have varied between 30 and 40 per cent in round numbers. These yields have been calculated on the weight of total sugars contained in the fermenting mass.

4. Accepting an average value between the two figures given above, as the probable commercially obtainable yield, we would have that a gallon of "final" or waste molasses, would yield about 2.1 pounds of the acid with a gross value of $1.68.

Finale.—As closing words I wish to express my firm conviction in the glorious future awaiting fermentation processes in the field of modern industrial chemistry, and especially in their application to carbohydrate materials. Indeed, many of our more important organic chemical products will be manufactured in a not remote future by methods of industrial microbiology.

The beautiful islands of the Caribbean offer unexplored treasures in their microbiological flora, and are destined to become great chemical laboratories of the future where fermentation industries will be predominant; and the future of our great sugar industry will be most intimately connected with such methods of manufacture.

Patent will be applied for by the author.

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